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ABSTRACT

A description is provided of an attempt at Harvard University to integrate course content with technology and the institutional setting. The course, "Communication in Societies," was aimed at non-science majors and explored the science and technology of communication and their effects on social organization. The objective was to impart an understanding of language and communication and enough command of scientific method and skills to mitigate the alienation from science found in so many students. The impact of the course on student attitudes toward science is examined, and the selection of course content, instructional methodology and grading patterns are discussed. Software and hardware used in the course are analyzed and a review is made of the problems involved in moving from experimental services to routine institutionalization. Attention is called to the needs to: 1) develop accounting procedures capable of projecting and comparing costs; 2) provide a better managerial structure for experiments; and 3) develop procedures which permit the handling of longitudinal data. A series of 12 appendixes gives complete details on the project. (Author)

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A Three-Year Report

31 May 1973

Project TACT

Technological Aids to Creative Thought

William H. Bossert Anthony G. Oettinger

Principal Investigators

Harvard University

Cambridge, Massachusetts

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... Special knowledge and the highly trained mind produce their own limitations which, in the realm of statesmanship, are of decisive importance. Expercise, it may be argued, sacrifices the insight of common sense to intensity of experience. It breeds an inability to accept new views from the very depth of its preoccupation with its own conclusions.

Harold J. Laski

A study of educational technology that is to be truly dynamic cannot shy away from the web of interrelationships which makes up the educational process. Curriculum development, teacher training, school architecture, selection of textbooks, production of television lessons, scheduling arrangements, budgeting techniques are intimately connected despite national associations, jargon and the traditional piecemeal thinking that have for years kept them apart.

Richard Hooper

Harold J. Laski, The Limitations of the Expert, Fabian Tract No. 235 The Fabian Society, London 1931, p. 4.

Richard Hooper, "A Framework for Studying Instructional Technology" in To Improve Learning Vol. II, Sidney G. Tickton (ed.), R. R. Bowker, New York, 1971, p. 139.

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Natural Sciences 130. Communication in Societies

Professors William H. Bossert and Anthony G. Oettinger

An exploration of the science and technology of communication among men, animals, and machines, and of its effects on social organization. Human speech, writing, and art and various examples of animal communication serve to introduce a scientific analysis of the fundamental characteristics of communication systems and of their role in organizing societies. Contemporary problems attendant to the rapid spread of telecommunications and computers are analyzed to shed light on the interactions between information processing technology and society. The course itself is an experiment in communication through various new forms of educational technology.

Note: Distinguished performance in this course is prerequisite to enrollment in Natural Sciences 131. *Enrollment*: Limited to 75.

Half course (fall term). Tu., Th., 2–3:30. 2069 (XVI, XVII)

1. COURSE IMPACT ON STUDENTS

A. Introduction

As spelled out in our proposal (Appendix XII), Natural Sciences 130 was to be "aimed primarily at students from the humanities, the social sciences and the School of Education and designed to impart to them both an understanding of language and communication and enough actual command of scientific method and technological skills to mitigate the alienation from science and technology now so prevalent in a majority of the college population."

The 1972-1973 version of our statement to students describing our objectives, requirements and procedures is given in pages II-5-9 of Appendix II.

We experimented with a variety of techniques for identifying significant aspects of the course and evaluating them. The diaries and course evaluations required of each student are rich sources of subjective data, excerpts of which will be cited where relevant. A reading of the diaries and evaluations reveals a wide range of variability among individuals that is surprising, given that the Harvard undergraduate body, as seen through the telescope of national test scores, is a very selective and homogeneous sample of the national student population. After reviewing the full set of student evaluations of one semester of the course, one dean commented that "the most striking impression I get is that students seem to be describing entirely different courses. How could people have such contrasting reactions to the same materials?"

Sustained systematic exploitation of diary materials did not prove feasible, although an attempt was made to do so at the end of the first year (Appendix VII). Page VII-5 of Appendix VII illustrates one attempt to mine diary materials for reactions to specific course elements. The very rough quantitative indications we obtained support findings from casual observation of unfolding events, but are too sparse and too vague for objective evaluation of, say, the exportability of visual products. Sustained high quality measurements require resources on a scale difficult to justify for application to a single course, a theme that recurs throughout this report and is the basis for our major recommendation for the future.

Fortunately, however, some aspects of our evaluation of our course coincided with certain interests of the Dean of the Faculty of Arts and Sciences reflected in tasks he had assigned to the Office of Tests of that Faculty.

B. Class Composition

Appendix VI-B presents details of an analysis of the composition of the Natural Sciences 130 student body. The data of most significant interest are summarized in Appendix VI-C for the three years in which the course has been given.

These data support the conclusion that the course reached its intended audience among undergraduates.

Over three years humanities and social sciences majors have increased from 61 to 71% of the class, while Natural Sciences majors have decreased from 11 to 5% (Appendix VI-C, Table 1). Although Table 2 of Appendix VI-C shows some variability in distribution by college year, both this factor and composition by major field are essentially stable and consistent with the composition of other Natural Sciences courses and with the distribution of students within Harvard College itself.

Table 5 of Appendix VI-C shows the comparative composition of the class and the pool of applicants for the class. Enrollment in the course was limited to foster individual interaction among staff and students, particularly in the supervision of student projects, by keeping the number of students per staff member roughly between 10 and 15. Selection of applicants was mainly random, with some consideration given to "hardship" cases of various kinds. Tables 5b and c along with Tables 1 and 2 of Appendix VI-C suggest that no significant distortions occurred in this process.

C. Outlook on Science and Technology

Data from the diaries, student evaluations and official course records were supplemented by data gathered through a questionnaire mailed to students at the end of each semester along with notification of their grade in the course. The construction of the initial questionnaire ('70-'71) and first-year findings are discussed in detail in Appendix III; details for the two later years are given in Appendices IV and V respectively. Table 6 in Appendix VI-B summarizes certain salient data for all three years.

Item g in Table 6 (Appendix VI-B) supports the conclusion that on the whole the course had a significant positive effect on students' outlook on science and technology.

A substantial majority of respondents in each year also reported undertaking follow-up activities (courses, projects, papers, future plans) they would not have considered otherwise (Table 6, item k). The flavor of positive effects on outlook on science and technology is reflected in the following anecdotal accounts extracted from diaries or student evaluations:

"But I probably would not say that Nat Sci 130 is a 'good' course - because what I am trying to get at is that for me, the value of Nat Sci 130 was not at all in its lectures, charts, slides of ants, videotapes of hermit crabs, statistics on the FCC, etc., but in the opportunity it gave me of becoming familiar with video equipment and watching my reactions. This is obviously very subjective and personal. Once again, before coming into Nat Sci 130, I'm telling it honestly to say that I'd been known on occasion to have trouble with nothing more complex than a simple extension cord (which gave me the hateful self image of a dumb-blond-in-need-of-a-strong-man, whimpering, whining, I-Love-Lucy type of a woman).

It would not be true to say that Natural Sciences 130 changed all this. I don't 'understand' machines any better; as I've said, I learned to operate the various equipment in Natural Sciences 130 by constant practice and repractice, until any one particular act or series of acts became mechanical and routine, not 'understandable.' If I started out the course with a certain fear of machines, equipment, apparatus, etc., it's true that, although I was in turn fearful of the Portapak, the AV3650, the EV320, the mixers, I learned, successively, to use each one relatively comfortably - and for me this was perhaps the most important lesson Nat Sci 130 had to offer. But, at the same time, the danger in calling this a 'lesson' is that it wasn't a complete one for me. If I had been hostile to technology and machines before entering Nat Sci 130, I still am, and as a result of my own experiences, may be even a little more so - since I now know how easily this equipment can break and completely foul you up, frustrate you, do the unexpected, screw your plan and your progress, and just plain kill you. (And let me also say that, even when the equipment was in perfect running condition, I don't recall ever having done anything as tiring, draining, depleting, and completely exhausting as trying to shoot or edit a faultless videotape, in a studio). I have come into contact with 'Types' who pretty much worshipped a particular piece of equipment - the Genlock, the EV320, etc. Like everyone, I too was amazed at the incredible repertoire of tricks these things could perform at the mere press of a button. But I never lost sight of the fact that they were, first and foremost, machines - and as such, they had merely to service and implement my ideas and designs. I hope I never get reverent to the point of forgetting that they were tools, nothing more, tools which I treated very gingerly because I knew that any minute they might up and cut out on me, the little bastards."

(Sophomore, A)

"The best thing about the course is the subject matter. Technology is advancing at an incredible rate and will probably continue to do so in the near future. Sometimes the changes appear to be bringing us to 1984 and other times to Utopia. I think it's necessary to have some general view of the way things are and probably will change, the basics of the technology and the immediate effects on society.

On one level, I now know something about communications vis-a-vis frogs, hermit crabs, Ma Bell, NBC, RCA, IBM and the FBI I didn't know before. Even if I can't do everything with videotape, at least I now know something about a Portapack. Most important, the course caused me to think about media and society. When I found out about the trick (!) of giving you access to my Harvard record (and God knows what else)*, I became a little more cautious. I found out that I really knew nothing about communications when I thought I was fairly well informed. The slow, deliberate, probing and critical tone of the class caused me to think about media and communications in the future before I come to conclusions."

(Freshman, C+)

"In retrospect, I see the experience of Nat. Sci. 130 as having been an enjoyable, and for the most part, an interesting one. At times throughout the course I was somewhat concerned that I did not feel I was adequately absorbing much of the technical kinds of information contained in the lectures. But perhaps, since I am not technologically oriented at all, that could not have been avoided. More important, I feel now, is the fact that having taken the course has a) added significantly to what I do know of the technical aspects of communications, and b) it has led me into the water (so to speak) and shown me the depth of complexity of many of the issues involved here - I am thinking particularly of the public policy issues re: telecommunications we looked at - controversial questions whose resolution will affect all of our lives in this society, be we 'technically oriented' or not.

(Sophomore, B-)

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*The course application for 1972-73 included the question "May we look at your Harvard record to get a better profile?" (Appendix II, p. 1), in order to set off a discussion of the propriety of such a question during the sessions on databanks, privacy and due process in December.

> "Bossert continues on Animal Communication. My God, even ants communicate!! At first I didn't understand the importance of the notion of diffusion, but after the computer illustration and the stuff that Bossert produced that everyone could smell, I began to understand. It is fascinating how a computer can be used for such studies."
>
> (Senior, pass)

While there is some comfort in data that show a positive effect of the course on students' outlook on science and technology for about 60% of respondents, approximately 10% of respondents each year indicate a negative effect and nearly 30% no effect. The characteristics of students reporting no effect are analyzed in some detail in Appendices III-V.

More significant, however, is the absence of any basis for comparing the effect of Natural Sciences 130 with the effect of other Natural Sciences courses. It might be the case, for example, that the characteristics distinguishing our course from any other make no significant difference as far as this effect is concerned. Unfortunately, making the comparison is contingent on the availability of comparable data from other courses. This requires an institutionalized evaluative machinery beyond the reach of an isolated effort.

Natural Sciences 130 is unique, at least at Harvard, in its subject matter and its emphasis in the same way that the secondary school programs in physics, biology and mathematics developed over the past two decades differ in content and in emphasis from their predecessors. Our experience is entirely consistent with the observation that some significant changes in content present no insuperable difficulties. But our data do not in themselves support any claim that the subject of communications is significantly better or worse a vehicle for changing attitudes about science and technology than astronomy, biology, energy or air pollution. Nor is it clear, in the absence of a control difficult to achieve, whether our particular pedagogical and technological approaches had a significant impact either way on the effect recorded in Table 6 g of Appendix VI-C.

Indeed, the stability of the effect over three years is remarkable in the face of significant variations in students' expressed attitudes and motivations, numerous minor variations in staff, in details of content and technique, some major secular changes in the external environment and, of course, complete turnover of students each year. We do not know how to account for this phenomenon.

D. Grading and Exogenous Factors

As indicated in Appendix III (page 17), much of our analysis of the effect of the course centered around a variable crudely defined on a scale from high to low interest. This focus was chosen on the assumption that "involvement generally secures the benefits -- personal and intellectual growth" of getting into a subject and that if "we could determine who did and did not get involved we might be able to say something about why, and what the consequences were." The details of our explorations on this score are recounted in Appendices III, IV and V and summarized in Appendices VI-B and VI-C.

Two major trends emerge from examining the indications of high interest in the course displayed in Table 6 b, c of Appendix VI-C. In general, expressions of high interest declined from 50% in the first year to 28% in the third year. Even more dramatic, expressions of high interest among students exercising the option of receiving a pass/fail indication rather than a letter grade went from 48% in the first year to 0% in the third year. At the same time, the percent of respondents taking the course pass/fail declined from 37% to 10% as reflected in Table 6-d. In this context, the constancy of the distributions in Table 6-g and 6-k is all the more remarkable.

As indicated in Appendix VI-B, page 25, overall college pass/fail enrollment peaked at 27% in 1969-70 during "the Spring of the Cambodian invasion" when "many students switched to pass/fail or other non-graded situations late in the Spring term." In the next two years, the overall percentage dropped to about 10%. The drop in pass/fail enrollment in Natural Sciences 130 thus can be interpreted as a trend toward the normal proportion and away from unusual initial conditions. Since 37% took Natural Sciences 130 pass/fail the year after the Cambodian peak, at a time when the college average had already reverted to 9%, that external factor does not seem significant.

Indeed, the high initial percentage can be explained on the basis of administrative factors that statistical analysis would fail to reveal. Given the experimental intent of the course, it was originally described in the catalogue as being available only on a pass/fail basis. This stipulation by the course heads contravened standing faculty legislation putting the option in the hands of the students and not the faculty. The unwitting breach was overlooked as the submitted course description wended its way into the catalogue.

However, early in the first semester of the course, the breach surfaced and remedial action had to be taken, particularly since students intending to use the course to fulfill the General Education requirement for a Natural Sciences course needed a grade. 37% of the class chose to remain enrolled as pass/fail students but some adjustment had to be made for the others, especially since switching into another graded course and catching up would have been difficult for them.

An informal bargain was therefore struck. Students who had enrolled for pass/fail but were now to be graded would receive a grade of B in lieu of pass unless extraordinary circumstances justified either a higher or a lower grade. The odd grade distribution for 1970-71 discussed in Appendix VI-B is primarily a consequence of this artifact although, as noted in that Appendix, certain other factors entered as well.

Still other reactions set in which help account for the trends noted in Tables 6-b,c,d,e and f of Appendix VI-C. As may be seen in Appendix VI-A, the undergraduate Confidential Guide to Harvard: A Review of Courses concluded its assessment of the first year of the course by commenting that "marking was, in general, very lenient - a B was given if any effort was shown", without noting the special accompanying circumstances.

Although no formal measures of the influence of this publication are available, it is generally thought to be highly influential among undergraduates. To forestall the growth of an image of the course as a "gut" and the consequent damage to the integrity of the experimental character of the course, special announdements were made at the early course sessions in each of the two subsequent years to clarify the choice of the pass/fail option and to indicate that ordinary standards would apply for those choosing to be graded. The exercise of the pass/fail option was, however, encouraged and may account for the delay in the reversion of the pass/fail percentage to the norm.

The matter was further clouded by the further accident of a verbatim repetition of the text of the 1971 assessment in the 1972 edition of the Confidential Guide.

However, a comparison of the chart on page 11 of Appendix VI-B with that on page 20 of Appendix VI-B and a reading of the accompanying text show that by the second year the grading pattern had already moved much closer to normal.* One may therefore surmise, in interpreting Table 6-b,c,d,e and f of Appendix VI-C that, by the third year, word of mouth about grading in the second year had counteracted at least to some extent the erroneous information in the Confidential Guide hence that students taking the course for grades were entering it like any other Natural Sciences course, perhaps with some residual expectation of easy grading.

The trend toward fewer expressions of high interest may therefore be interpreted as a return toward normalcy through increasing reluctance on the part of the students to take at face value the claims of the course to experimental status. This observation is reinforced by examination of Table 6-c of Appendix VI-C. Self-assessment of interest factors was requested at a time when each student already knew his grade. In the first year even the C students, who might have had reason to complain that they were treated harshly in terms of our bargain, responded just like the B students. In the second and third year, neglecting the circled entries, there is a suspicious correlation between professed high interest and grade received.

---

* Possible contributions to this pattern by general grade inflation and by a drop in student caliber are noted on p. VI-B-18.

It is unfortunate that the unavailability of data for 1970-72 in Table 6-f and of a scatter diagram comparable to that in Appendix VI-B (page 20) for 1972-73 makes interpretation of the disparity between expectation and actuality both difficult and premature. However, some interesting conjectures suggest themselves. The preponderance of entries in region A of the scatter diagram of page 20 of Appendix VI-B suggest that the course might either not have been as experimental as the staff believes it to be or else that, in spite of certain experimental aspects, our judgments of the quality of student performance nevertheless were consistent with judgments made in more conventional ways.

The outliers in region B are few but the question remains whether these are due to students finding themselves trapped in an unfamiliar area through an effort to broaden their interdisciplinary view or whether there was some error in judgment by the staff or some other accident. The outliers in C are more numerous. They may reflect some soft-headed leniency as a hangover from the first year's pass/fail imbroglio, or a tendency to reward artistic merit as in video production, thereby favoring students who might be judged more harshly in a conventional Natural Science course that puts greater emphasis on normal scientific performance and more traditional examinations.

So far we have commented on the relative constancy of course effect on students (as reflected in Table 6-g and 6-k of Appendix VI-C) in the face of variations in student attitudes and expectations. However, comparison of the trends in Table 6-b and 6-h, especially with respect to the sharp drop in both percentages between the second and third year, might suggest that staff performance e deteriorated, particularly between the second and third year. Table 6-m is interesting in this respect: a sharp drop in the number of students reporting that they liked the staff occurred between the first and second year, consistent perhaps with the evidently harsher grading of the second year. But the constancy of that factor between the second and third year suggests that staff personality and grading pattern might be less significant in student evaluation of staff performance than some aspect of content selection.

The data of Table 6-r and s of Appendix VI-C are subject to a similar ambiguity. On the one hand, the drop in those reporting that they would take the course again might be attributed to wider realization that, in terms of grading, the course offers little advantage over alternative Natural Sciences courses. Alternatively, some aspect of staff performance or content might be at play. The interpretation of these data and those of Table 6-e and f would obviously benefit from comparable data for other courses.

The drop in professions of high interest by those who elected pass/fail and passed (Table 6-c) is much sharper than the overall drop in expressions of high interest (Table 6-b). The most obvious interpretation is that over the three year period of reversion to the norm, pass/fail students tended to use the course less and less as an opportunity to explore new areas and more as a course to relax in while keeping up with pressures elsewhere. A mechanism that may be at play is suggested by the following student comments:

> "The external problem is that the structure of Nat Sci 130 does not fit into the present structure of Harvard. Harvard courses are very achievement oriented. The desire to earn a high grade has become a more important incentive than the desire to learn. Harvard courses are in general very time consuming. In most courses, no matter how much time one dedicates to the course,

one never completes *all* the specified work, especially if it is in the form of extensive reading lists. Also, it is generally true of Harvard courses that the student is unable to exert any *initiative* in deciding what he would *like* to learn. Each of these three conditions creates problems for the Nat Sci 130 student. Nat Sci 130 is not meant to encourage the grade-earning initiative and does not require the completion of an extensive prescribed work load. We were urged to take Nat Sci 130 pass/fail. I agree with the staff that having to administer grades would counteract one of the purposes of the course. But some students, like myself, have to be graded to fulfill a requirement. Also, the awareness of being graded in other courses coupled with the time consuming nature of most other courses causes a definite time conflict for the student. For example, a student may have to decide between reading a book which will be covered on an up-coming hourly or reading a book for Nat Sci 130 out of general interest. It is difficult not to choose the former ... Moreover, one after another of these types of deadlines occur all term. Thus, work for Nat Sci 130 may be continually postponed, not out of procrastination but out of logical necessity. Finally, it may not be very easy for a student who is used to the typical Harvard course to deal with the change in incentive of Nat Sci 130. It is not always so easy for a student who is accustomed to following a prescribed work schedule to channel his initiative into designing his own plan of study. It does not seem to me that the above-mentioned conflicts are resolvable until the structure of other courses is changed. However, it seems to me that these changes are slowly taking place and that the pace of change will quicken."

(Junior, B-)

"My plans didn't come off very well: I attended most of the class and read up on topics that I wasn't familiar with, selected a project more from a teaching than learning viewpoint (which project didn't get very far), but basically I had a passive, relatively uninvolved relationship to the course.

One personal problem was that I had never taken a pass/fail course before. I've tried to convince myself that grades don't mean that much to me in terms of what I want to learn and do, but I guess 15 years of conditioning aren't that easy to snake off. I kept giving my work for graded courses higher priority -- I also had two exams left over from last spring which complicated my schedule further. I didn't fully appreciate the considerable Independent Study nature of the course, and kept expecting to find more or less what I wanted in class meetings. Not that I think the course shouldn't be pass/fail -- they all should.

(Senior, C)

2. CONTENT AND METHOD

A. Content

Our principal objective was "to determine the real potential of an appropriate gamut of educational media in a laboratory situation where political and institutional problems are minimized and where the choice of equipment and of the pattern of instruction can be made to flow logically from the intellectual structure of the materials to be presented and the capabilities and needs of students." (Appendix XII, page A-1). Tentative approaches to these goals were suggested in Appendix XII.

The course content that evolved is sketched in the materials of Appendix II. Significant visual and other materials prepared particularly for the course are listed in Appendix I-A. The institutionalization of software and hardware is described in Section 3.

The neat spiral structure envisaged in Appendix XII proved unattainable within a combined experimental and operational context in which events and the investigators shared the saddle in a fashion that now makes the assumption (Appendix XII) of a "laboratory situation where political and institutional problems are minimized" seem naive. The broad implications of that realization are traced in some detail in "Will Information Technology Help Learning?" a major publication resulting from this project and cited in Appendix I-A.

The spiral idea remained in the use of Claude Shannon's well known conceptual diagram of information flow as a unifying concept in describing the biological and technological communication systems used as examples in the course. The power of this model and of the mathematical tools developed to support it was illustrated in some detail in our treatment of the scientific basis of contemporary computer and telecommunications technology and of the scientific description of the biological communications systems involved in the fighting behavior of hermit crabs and the food foraging behavior of ants.

However, the trend of thought elaborated in "Will Information Technologies Help Learning?" also led to a much heavier emphasis on broader aspects of information technologies in human society than had been contemplated in the earlier sketches of course content. While the Shannon model retains some application as a broad metaphor, the formal scientific and mathematical apparatus so valuable in making technology intelligible has no value in tracing the mutual influences of technology and social organization.

B. Breadth or Depth?

A broad "smorgasbord" approach was selected over the treatment in depth of a narrower realm on the assumption that presenting many related ideas in a mutually reinforcing context is better tailored to giving students an insight into the web of relationships among scientific, technological and public policy issues related to information technologies. It also seemed that the likelihood of some subject engaging the attention and commitment of our diverse students would thereby be increased. The emphasis on a project grew out of a desire to balance the superficial presentation of broad overviews by the staff with an opportunity for each student to pursue and to master a topic of particular interest to him in great depth while supported by both the context of course presentations and considerable individual attention and guidance by the staff.

Items h, i, j, and l of Table 6 (Appendix VI-C) shed some light on student responses to these decisions. A pronounced majority of respondents reported favorably in all three years on the "broad range of interesting topics" offered in the course although this percentage dropped in the third year for reasons suggested in the preceding section. At the same time, however, a significant minority of respondents reported negatively on "superficiality of course content", a factor intended to suggest the obverse of the "broad range" coin. The figures in Table 6-h and i indicate that some students responded to both sides of the question in an apparent contradiction deserving attention in any more definitive effort at questionnaire design. Between 10 and 15 percent of students also reacted negatively to "excessive freedom and insufficient structure in the course" (Table 6-j).

Student comments in diaries and evaluations help shed some light on the origin of the sharply contrasting student responses.

> "The biggest problem that I found with this course was that it seemed to be very disjointed, both in the topics and the way that they were presented."
>
> (Senior, pass)

> "In general the course lacked organization. For example, I think it would have made much more sense to discuss some general theories about communication before zooming off onto tangents like the Bell Telephone System. I don't think some minimal organization of this sort would have interfered with the freedom of the course.
>
> (Junior, B)

> "The structure of the course was loose -- a bit too loose; I felt that when the course had finished there was no whole to look back on, but a series of units, not drawn together."
>
> (Senior, pass)

"Also in order would be an examination of others' attempts at this; there must be some philosophy of communication worth examining in Nat Sci 130. I got tired of asking myself, 'But what does this have to do with anything?"

(Junior, pass)

"Generally, I think that the course should be reexamined in terms of its goals, and be made more focused. It trys too hard to do too much - and, for me, succeeds in doing neither little of everything nor a lot of anything."

(Senior, B)

"Starting with structure, I am told that the introductory lecture mentioned a lack of it. It was confusing not to be able to discover any dominant personality or system to order the course. It was scary to be given new material and told to be creative. It was frustrating to try to find a big picture. I guess a lot of people in the course already had theirs, and could ignore everything that didn't fit. I spent a lot of time panicking because I took the course for a grade. For some reason I felt privileged to be in the course, and I think this, along with the fact that the teaching fellows seemed to be really interested in two way communication, and that others needed to be reassured as to their efficacy contributed to my own feeling of paranoia."

(Sophomore, A-)

"A course such as Nat Sci 130 should be required of all Harvard and Radcliffe students during their freshman of Sophomore year. It has the tremendous advantage of being interdisciplinary. So often when the time comes to select a field of concentration, an uncommitted student will choose something because he has had a great deal of exposure to the subject in high school. Had they dared to take a course in Linguistics, or animal behavior, or math theory, etc. before being told to pick a major they may well have chosen some new field of interest. A course such as Nat Sci 130 could have introduced them in a very gentle and unscary way to numerous disciplines that they have never heard of, or that they might have been too scared to explore in a full, regular course. Having found a new interest, they could have then done their term project on a somewhat more indepth study of their new interest to see just how valid it was."

(Senior, B)

"For this student who had very little knowledge of animal communication, computers, linguistics or related fields, Natural Sciences 130 was the ideal course. It allowed me the chance to dabble in introductory "mini courses" in each of these fields while it likewise allowed for an opportunity to concentrate on a topic that truly stimulated me."

(Freshman, A)

"All in all though, the course expanded my perspective. It showed some of the harsh realities of communications - the influence of business and public policy - to one who as an artist tends to idealize. Oettinger's lectures were very helpful in this - for me, it was like hearing a voice from a world that I hadn't known existed."

(Senior, pass)

"I take it for granted, to begin with, that the subjects of investigation are carefully chosen, but chosen with an eye to the fact that for every subject chosen there are any number equally as pertinent. But the way in which the frustration of shallow content was best allayed in the course was when the lecturer dealt with one situation as representative of the greater situation. For instance, when Bossert discussed animal communication, he did not try to go into the communications in love and war within each species of all animals. He looked at the frog pond, on one day, and a hermit crab pool, on another. These classes, looking at the macrocosm by way of the microcosm, inasmuch as the subject was not to be discussed in the next class, were very satisfying. ... Although the topics discussed each week were different, as a body of teachers, students, and subject matter, the course was remarkably, an entity, and in light of four years of courses at Harvard, this is a special quality in itself."

(Senior, B+)

"On a couple of occasions I was remiss in covering all the material which was required and instead devoted my energy to a project in which I felt I was making significant headway. However, I also knew that this occasional shift of priorities was permitted in the understanding that was outlined in September."

(Freshman, A)

"This reluctance to compartmentalize the course I find highly laudable - human experience does not come prepackaged in neat little categories, and a topic as general as communications deserves as broad a treatment as possible."

(Senior, C)

"All in all, I really liked Nat Sci 130. It made me think, and try to tie many different areas together. It was always interesting and quite often surprising. Having to think about the class, and write a diary on what I was doing were both very stimulating and made me think more about my other classes as well."

(Freshman, A)

"When I sit down to consider how I feel about Nat Sci 130, many things come to mind. The first is the great frustration that I felt during the first half of the course because I was treating it entirely wrong. I was expecting a course that would move and progress in some kind of coherence. I don't think Nat Sci 130 is designed that way and I'm glad today that it is not. When I realized that what I was supposed to do was to be a sponge and sort of soak up all that was offered and then squeeze out most things but save what was valuable to me. This means that the course is a different experience for each student and this is good if the student can be made to feel that this is the purpose of the course. It is really the antithesis of most of what a Harvard Education is all about. In most courses one realizes that everyone is supposed to get the same experience and therefore learn the same things. I think that at the introductory level and below that the "sponge" technique is good. I may never follow up anything that I learned from Nat Sci 130 or then again I might get involved in things that would revolve around what my project was all about, but either way I was exposed to many things that I would not in any other way have been exposed to. I really think this is the value of the course. I don't think it would be very valuable for anyone who has a strong interest in any aspect of the course going into the course to take it. They would probably be frustrated by the lack of direction and should consider the independent work or independent study option."

(Junior, B)

> "Although many people have obviously complained about the 'meandering' quality of this course, I found it to be a refreshing change from the usual restricted, authoritarian 'ten pages is due' 'why' 'course requirement, that's why' nonsense that is the usual procedure here. My only wish is that Dr. Oettinger had perhaps made the goal of his lectures a bit clearer at the beginning of each lecture, often one got a bit lost trying to follow him. I have learned quite a bit about a variety of subjects, the term paper I've written perhaps was no more valuable than any of the major groups of lectures, but it was an important as that. I've had the mysteries of FM and AM explained to me, I know quite a bit more about what folks at Bell Laboratories are thinking about. I'm a little bit more informed, and a lot less trusting of the 'experts' in any field. I have learned a lot about how various people think about communication and something of how I approach the various issues. For me the course was a complete success and I hope the more obsessive-compulsive Harvard types stayed away."
>
> (Senior, B-)

> "The immediate benefit of this course for me was that I was able to attend films, video showings, television shows, and lectures around Cambridge in which I was interested and integrate these events into my academic work. The great triumph of Natural Sciences 130 was its integration of diverse spheres of thought and integration of intellectual thought with the business of daily living. A practical streak distinguished this course from others in my academic career."
>
> (Senior, B)

C. Student Projects

The percentage of students reporting that "they liked their project" held steady in the mid sixty percents throughout the three years (Appendix VI-C, Table 6-1). The following are illustrative student comments about projects:

> "PROJECT: I feel in some sense very guilty about this because mine was very slapdash. I justified this on the grounds that since the project, which was completely inspired by this course, will probably be my thesis topic next year, it is not as if all is wasted - especially since I plan to take another course on it this term."
>
> (Junior, pass)

"The work load was very light but I still learned a great deal. Keep moving toward a more logically organized course while keeping the freedom which makes this course different from most of the rest."

(Freshman, A-)

"I am surprised that students in the past found the course to be a gut. It seemed to demand quite a bit of time and energy because of the requirements such as the rough draft of the project and the videotape."

(Senior, A-)

"The course could even be justified from the standpoint of the project alone. in that it allows a student to spend time on his personal interests and offers him college credit for his work. This is really a very good deal!

(Freshman, C)

"Another pleasing aspect of the course was the freedom on projects. I was very interested in doing a videotape, and although my project did not turn out exactly as planned, it nonetheless was a great experience and I feel it worked well. The free nature of the project enabled me to experiment freely without feeling that I would be jeopardizing my standing in the course. The project is an excellent way to learn, far superior to an exam, and I would urge its continuance just as it it, with no strictures."

(Senior, C-)

"The project could be the strongest or weakest part of the course, depending on the student. The experience and knowledge I gained through conducting my project was much greater than I had ever hoped. Projects are absolutely necessary in the course; the student is presented with many possible areas for study in communication through the half year, and the project affords him his only opportunity to concentrate and specialize on that area of interest to him; the project serves as a major or concentration within the course."

(Freshman, A)

"For me, the mitigating factor was my project, which I enjoyed enormously, and learned a great deal from. And I must admit, that though I griped to myself about the 5 minute videotape exercise, I enjoyed doing it, though resented the required nature of it. (Perhaps it might be optional?)

(Senior, B)

"I also liked the flexibility allowed in projects, for it allowed people to be creative or to mold their projects to fit their particular field of interest, as they chose. Of course, it also left open the option of experimenting with an idea totally foreign to one's previous experiences.

I appreciated the fact that the videotape was mandatory. It takes a certain degree of determination for a student who has had little or nothing to do with videotapes to go about checking the equipment out and actually filming something. Of course, once done, it is both educational and enjoyable."

(Sophomore, C+)

"I've just finished writing up my project, and since that's still in my mind, I guess I'll begin my evaluation of the course by talking about the project idea. I can't praise it strongly enough. It's simply wonderful to have free (almost) choice of what you want to work with. The main pitfall is the inevitable tendency to procrastinate. This was certainly true for me: I didn't begin mine till Thanksgiving, and didn't write it up till yesterday. The October interview and deadline for proposals definitely should be preserved to at least force one to think about the project. But except for that the student should be free to progress at his own rate, as was the case.

The videotape requirement is a good one, considering the emphasis placed on communications media in the course. It's really valuable for understanding at least a little of the workings of such things. Besides, it's fun. I wish there were funds for one or two more sets of equipment so that they would be more easily available. I was a bit ashamed of the tape I finally turned in; more experience might have made a decided difference.

(Sophomore, A)

D. The Videotape Assignment

The last three student comments report favorably on the videotape assignment, a response shared by 78% of respondents in both years when videotape usage was mandatory (Table 6-p, Appendix VI-C). Ten percent or less of respondents reacted negatively to the videotape requirement (Table 6-q).

The videotape requirement was introduced in the second year of the course. The principal motivation for this requirement was to assure at least some concrete exposure for each student to the actual manipulation of elements of modern information technology. The use of exercises at a computer console was an obvious alternative. However, the use of meaningful computer exercises would have implied a greater emphasis on computer technology than seemed desirable in this course, especially so since one of the principal investigators was already responsible for another General Education course devoted entirely to introducing computers and computing technique. The decision to use videotape was also timely. It coincided with the first appearance on the market of a variety of affordable and reliable half-inch videotape equipment and with public debates on cable television policy including the question of public access to cable channels. Finally, mandating the production of a 5 minute videotape opened up the opportunity for students to express their projects through video rather than conventional written exposition.

While definitive conclusions are premature, the experience of reviewing nearly 100 5-minute productions in each of two years suggests that the quality distribution of student productions is comparable to the quality distribution of written papers. In each year there were 3 or 4 products outstanding both in content and technical quality, a few content-free and technically botched efforts at the other end of the scale, and a bulk of reasonably competent but not exciting efforts in between.

The context and the implications of such a finding are discussed in the section "Personal Contributions to Memory: Rights and Limitations" of "Will Information Technologies Help Learning?" We believe that if the trend toward better yet cheaper videotape equipment continues and larger numbers of students are exposed early in their schooling to motion picture production, whether on videotape of on film, limitations on the amount and quality of teaching or learning materials available in this medium can cease to be the critical bottleneck they are at present. We return to this point in section 3 in our discussion of staff production of video materials.

E. Innovation?

Content aside, how were the course's departures from traditional format and technique perceived by the students? As shown in Table 6-n of Appendix VI-C, only slightly over 50% of the respondents in the first two years and only 44% of the respondents in the third year reported favorably that "the course was experimental". Less than 20% of the students in the last two years reported negatively that "the course lecture format was too traditional" (Table 6-o). The negative comments on superficiality of course content, excessive freedom and insufficient structure cited earlier in this section may well be comparable in kind and intensity to negative comments about any conventional survey course and not an index of innovation! Here again, there is no readily available base line for comparison.

The following comments from student evaluations suggest that in some cases at least the course was perceived as essentially different from other Harvard courses but give no basis for any broader generalization:

> "The lectures constantly repeated the idea that the course was experimental, but they presented few things which I hadn't seen before in a more organized fashion. I couldn't help feeling that it was largely oriented toward freshmen who had no notion of the freedom possible in most Harvard classes. In actuality it was no freer or more spontaneous than most courses.
>
> (Junior, B)

> "However, just the novelty of the course proved, at times, a disadvantage. I believe that many of us are unaccustomed to participating in a classroom discussion (especially in a relatively large group) that this somewhat inhibited discussions.
>
> (Junior, pass)

> "Unlike the other courses I have taken here (grand total 4) the lack of highly specific structure (i.e., tests, quizes, etc.) places the responsibility on the student to learn rather than on the professor to teach. This means, in effect, that though such an emphasis makes it easier (I think) for a student to get through without working, it also becomes harder to learn. I would suspect that this is why the Confi Guide missed the point on Nat Sci 130. Whoever wrote the evaluation of 130 did not try to learn, thinking that everything important was said by the professors.
>
> (Freshman, B)

> "Natural Sciences 130 is one of those open-ended courses where whatever you get out of the course depends on what you put into it. The resources in expertise, equipment, variety of subject matter, and introduction to different areas of exploration, and willingness to help are all there and in greater abundance than almost any other course I have taken at Harvard. The opportunities are endless and the atmosphere encourages you to try new things. If, as a student, you're quite sure what you are looking for, then this format is ideal. If not you begin to feel lost and pulled in many different directions with no sense of coherence."
>
> (Senior, C+)

"Nat Sci 130 has been so different from what I've been used to that it was a little hard to adapt to it. Hence, I didn't get from it all that I could have nor did I give it all that it deserved. Perhaps other students had experiences similar to mine. If this at first discourages the staff, it shouldn't. The staff of the course should realize that Nat Sci 130 is on the right track, that any overwhelming changes made should be made in students' attitudes toward learning and not in the principles on which Nat Sci 130 is based.

(Junior, B)

"I have enjoyed this course very much. It is probably one of the most unusual courses I have taken here in its flexible approach and flexible requirements. I have had the feeling from the beginning that what was to be gotten from the course was a matter of individual input. This is so with every course, but especially here, because beyond the minimum requirements of the 5 minute tape, critiques and projects, the amount of reading and which reading was up to us. (A "menu" book list is a very good idea. I will use it in the future for all sorts of things). The best books for me were Susan Langer's Philosophy of Language and Stuart Altman's Social Communication Among Primates and Leonard's Education and Ecstacy (some reservations about the last) ... Last, but not least, this course is unique because of the staff. Rarely have I had a real feeling of a group of people working to make a course happen. The styles and personalities are very different and each have something to offer. The interactions between members of the class sparked off more lively discussions with the students than is usual in so large a group.

In short, Nat Sci 130 was a living part of my semester, and will stick out in my memory with my primate communication project, my first computer hacking, and a few people as highlights.

(Senior, A)

"I felt the staff could have made more of an effort to be involved with the projects and interests of the students. I found faculty outside the course more ready to help. I am glad of having an excuse like a final project for N.S. 130 to find that out, but I think it is not a positive characteristic.

(Junior, B)

> "The dynamics of this course were drastically different from those in most others I have taken. Rereading the handout Natural Sciences 130, Fall 1972 has new meaning for me now. "To create an atmosphere in which information, resources, and assistance are abundant and in which you have the liberty and the responsibility to choose for yourself what you need and how you [illegible] get it." The statement is an accurate description of the course as I experienced it.
>
> (Senior, B)

F. Instructional Technology

The foregoing discussion has concentrated on broad structural aspects of method. What about the use of specific audio-visual and other techniques? Attempts at routine and systematic use of audio-visual devices raised major contextual and institutional issues discussed in "Will Information Technologies Help Learning?" and in section 3 of this report. Student reactions were mixed:

> "Except for one connection to the Mathews studio at the beginning of the semester, the monitors were used to show book covers, graphs, and other still lifes, all of which could have been accomplished equally well by an overhead projector, which I believe is a great deal less expensive than four monitors and a video camera.
>
> (Junior, pass)

> "Audio-visual equipment was not always used to its best advantage - the flashing lights and op art was nice, but graphs and charts were impossible to read.
>
> (Junior, D+)

> "The use of media was, to be kindly, poor. If computers are often used as "expensive page turners," then television was used in this course as an expensive blackboard. None of the media were allowed to show a potential for information transfer. Performance was erratic, reliability poor.
>
> (Senior, B)

"With the media available in Harvard Hall, the potential for high educational involvement is very high. But to use such media effectively requires true showmanship, a finesse, and most of all a technical knack. Polish up! My eyes still roll when I think of that Conrac monitor which never could maintain a vertical hold"

(Freshman, A)

"Certainly I grumbled when tapes had to be changed, televisions didn't work, microphones didn't transmit, videotape recorders were replaced, overhead lights improperly installed - but that has been largely forgotten."

(Senior, B)

"The video on the telephone company was one lecture that sticks out in my mind - I personally found it boring. Perhaps something could be done to perk up that tape?"

(Senior, B)

"Looking back, the highpoint in technological education in N.S. 130 seems to have been the telephone exchange tour as conducted by Professor Oettinger. It was well photographed, making optimum use of the medium, incredibly informative and involved the excellent personal touch of being conducted by a man we were all familiar with."

(Junior, A)

"Though some of the videotapes were amateurish, the effects they succeeded in making were many times more powerful than equivalent effects in professional films. The reason is that I, as a member of that class, knew that the film's creator was in that class too. When a technique in the film worked, I could appreciate it; and more than that, it made me want to go out and use it -- crisp audio effects and great zoom shots."

(Freshman, B)

"The use of audio-visual equipment throughout the term was excellent. The slides, films and videotapes used to augment presentations greatly added to the presentation. I also liked the idea of screening optional films after class and think this should be expanded and scheduled."

(Freshman, B+)

> "Regarding the use of educational technology, I was very favorably impressed. Holding classes at the Loeb, Sanders Theatre and Pierce Hall as well as in Harvard 104 while experimenting with various instructional media -- most notably computers, videotapes, slides, sound tracks, live orchestra conducting, and films -- offered the student fascinating diversity and an opportunity to acquaint him/herself with electrical and mechanical communication devices. In my estimation, Dick Land's lecture of October 17, though criticized from the standpoint of course continuity, made the best use of modern electrical devices for educational purposes."
>
> (Sophomore, B-)

> "On the other hand, the high points of the lectures were invariably (for me) the occasions when the learning environment was significantly raised, transmogrofied beyond a mere "lecture", either by the successful integration of various media presentations, (videotapes on related topics; audio tapes of animal sounds, bird calls, etc.) or by a total shift in the surroundings (the electrical demonstrations in Cruft, the rehearsals at Sanders Theatre). In some cases there were technical difficulties which detracted from the effectiveness of the media presentations. Clearly something needs to be done about making everything 'work' in Harvard Hall."
>
> (Senior, C-)

In the first year an effort was made to glean more specific details from the diaries. The resulting data are shown in Appendix VII, page 5. As noted in section 1 , the first year attempt to scan diaries against checklists was not followed up. Some thoughts given in the second year to eliciting questionnaire reactions after each session were abandoned owing to the press of higher operational priorities at such times and the difficulty of designing and calibrating an appropriate instrument.

It is noteworthy however that the fourth item on page 5 of Appendix VII gives the highest positive rating to a change of setting of the type commented on by the last two preceding student evaluations. Moving the whole class to a Law School classroom clearly stirred interest and stimulated discussion, although the value and generalisability of this effect is hard to assess. While classrooms used by the Faculty of Arts and Sciences are invariably designed in traditional lecture hall or theatre row format, many classrooms at the Graduate School of Business Administration and the Law School have a semicircular layout with swivel chairs conducive to a greater sense of intimacy, more active participation and higher quality of discussion than the layout where all students face the lecturer and changes of mutual orientation are difficult.

G. Diversity

The most striking characteristic of all our observations is the diversity of student reaction along every dimension considered. In his review of "Will Information Technologies Help Learning?" (Appendix I-B), Charles Wedemeyer commented that "another possibility which arises from the authors' treatment of the no-significant-difference syndrome is that the research may be right after all. It is hard for educators who feel personally identified with the particular method or approach which they use and find comfort in, to perceive that that particular method or approach might not actually make any difference in terms of measured learnings. This seems so monstrous a suggestion that it is dismissed as evidence of poor research, poor instruments, or inadequate methodology. The possibility rarely occurs to anyone that perhaps the research is right, and that may it doesn't really make any difference how the learner is taught.

"While such a possibility seems to denigrate the importance of the teachers methodology, it also implies an elevation of the learner to the central point in the teaching - learning process, something which progressive theories of education have long demanded. What if, for example, the computer known as the human brain is so sensitive, so adaptable, so vast in its capacity to cope and adapt to the problems of the individual, that it can 'learn' with relatively the same efficiency from almost any method or approach? If this is true, then a number of mystiques about teaching and learning must fall."

The diversity described in Appendices III-VI and more especially in the student comments does not contradict Wedemeyer's hopothesis. However, further alternative interpretations also suggest themselves. It may be that differences significant to individuals are averaged out in any statistical analysis of the reactions of many individuals to a particular learning situation. Some people were clearly very deeply affected by our course, others scarcely touched at all. That is likely to be true whatever the experiment. What changes is who is where in the distribution. Our analysis is scarcely detailed enough to do more than suggest how varied individual reactions were along the different dimensions we analyzed. Or there may indeed be no significant differences in terms of what can be measured, or easily found out, e.g., changes in outlook on science and technology, follow-up activity, general grade distribution. But what can't be easily measured, e.g., real interest, involvement, emotional responses to course, staff, long-term effects, etc. -- these vary greatly, and whether or not in response to deliberate manipulations by the manipulators.

One might surmise that those who commented negatively on excessive freedom and insufficient structure in the course would have reacted much more favorably, if not to some form of programmed instruction, then at least to a much more classical delineation of mandatory readings and of specific materials to be mastered by some deadline for some specific examination consistent from year to year. One might surmise that, conversely, those who thrived in this course would have been at least unhappy under other circumstances and possibly would have performed differently and been influenced differently both in their minds and their emotions. In any case, it seems to us that even the most ardent advocates of individualization of instruction have underestimated diversity.

Where we come out in the polarized arguments between advocates of unstructured and of structured instruction is with a plague on both their houses and agreement with Richard Hooper's observation that this "is not so much a matter of opposing strategies as of different points along a continuum stretching from TOTAL FREEDOM to TOTAL CONTROL".*

One approach toward taking these observations into account would be to identify, for example, students who prefer a more structured or a less structured environment for some particular purpose at some particular time, then to tailor instruction accordingly, either by putting them in the situation they prefer or by forcing them into the other, depending on one's outlook on the pedagogical or social constraints of this alternative. Taking this path presupposes a capability for pretesting and pre-evaluation that presents serious difficulties both intellectual and operational. It is in any case far from clear whether homogeneity in some cluster of attributes is sufficient to guarantee homogeneity in other perhaps equally important attributes.

Another approach to dealing with diversity of learning style would be to encourage diversity of teaching style and learner choice. If styles go with particular courses, no one would be learning or happy all the time, but neither would anyone be not learning or unhappy all the time. In a more elaborate vein, the Carnegie Commission cites a document from a Dartmouth physics course which "also advises students that another physics course, 'with more nearly equivalent content' than in previous years, would be taught in the conventional lecture mode simultaneously by another professor. 'If ... you decide that if [Physics 13] isn't for you, you may transfer to Physics 3 ...'".* As Hooper points out, these two extreme approaches only suggest a continuum of possible strategies.

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* Richard Hooper, "A Framework for Studying Instructional Technology" in Sidney Tickton (Editor) To Improve Learning, Volume III, R. R. Bowker, New York, 1971, p. 142.

The practical consequences of diversity have been discussed at length in Run, Computer, Run.** Factors entering in the balance between tailoring and mass production are described in "Will Information Technologies Help Learning?".

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* The Carnegie Commission on Higher Education The Fourth Revolution: Instructional Technology in Higher Education, McGraw-Hill, Hightstown, New Jersey, 1972.

** Anthony G. Oettinger, Sema Marks, Run, Computer, Run: The Mythology of Educational Innovation, Harvard University Press, Cambridge, Mass., 1969.

3. SOFTWARE AND HARDWARE

A. Conventional Services

Harvard's libraries provided the basic support for usage of books and periodicals in Natural Sciences 130. The menu of books reproduced on pages 11-17 of Appendix II and the list of articles on pages 18-20 of that Appendix served students as entry points into readings likely to be of use to them during the course.

B. Reprint Services

When the course was initially planned in 1970 there was no textbook or monograph source of germane scientific and technological information suitable for the predominantly lay student body of the course.

Over the years, however, many germane articles have appeared in the *Scientific American*. While W. H. Freeman and Co. occasionally publishes books of collected *Scientific American* articles on specific subjects, no suitable collection appeared until the publication of the September 1972 issue on communications and then of a book with the same content.

We chose to rely heavily on *Scientific American* materials because they provided an appropriate scope of subject matter under an editorial policy intended to produce authoritative articles understandable to a literate audience of non-specialists. Anyone who has contributed to the *Scientific American* will appreciate the unusual care taken by the editorial staff and the unusual pressures put on authors toward meeting that goal with respect to both text and illustrations. That the editorial objective is not primarily instructional in the classical textbook sense is all the more noteworthy.

With the cooperation of the Scientific American, we established a file of multiple reprints or xerox copies of potentially useful articles. Articles from other sources and unpublished reports were subsequently added to the collection. Appendix VIII reports some data on usage of the file during the academic year 1970-71.

The file was created in the belief that exclusive reliance on periodical collections would put an intolerable burden on the single copies normally kept by libraries. However, as shown in Appendix VIII, only about half the students in the first year of the course used the file. Reports in student diaries are inadequate to tell us precisely how many of the remaining students used the Scientific American in libraries and how many did not. However, those reporting such use often noted that libraries were open and accessible for many more hours than the room where our file was kept. In the first year, security problems kept us from keeping the room opened and unattended; in the second year, students were given keys on request and, by the third year, the file was kept with our video equipment in an area manned most of the time between 9 and 5 on weekdays. The data in Appendix VIII give a mildly interesting account of a portion of the reading habits of the students using the file.

As noted in "Will Information Technologies Help Learning?" the use of non-textbook print materials is rapidly growing in all colleges to the dismay of textbook publishers. While libraries are not well equipped to deal with this kind of material our experience suggests that ad hoc alternatives run into financial/administrative problems of their own. Library system problems remain as critical as any problems with more exotic technologies. However, the labor of experimenting with and appropriately instrumenting various processes for access to library collections seemed too onerous and too peripheral to justify more concentrated and better planned efforts beyond the first year.

C. Video Services

During the second and third years of the course the development of videotape facilities was emphasized as means for hands-on experience with some modern hardware and also to test our hypothesis that both the "classical" view of instructional television (as embodied in educational television broadcast stations or in the elaborate studio facilities pioneered at such campuses as Pennsylvania State University) and the high cost and closed-shop professionalism associated with this tradition might be usefully challenged through deployment of emerging half-inch and one-inch videotape technology.

We therefore sought to explore what could be done, how and with what quality by making relatively inexpensive equipment easily accessible to both staff and students but without investment in elaborate studio facilities.

Staff video products are listed in Appendix I-A. In the preceding section, students mentioned both boredom and enthusiasm about a tape the staff made to illustrate the path of a telephone call from a speaker to a hearer. A live tour might have been better but it was impractical because of the large number of students involved and of concerns over Central Office security. This tape illustrates the use of video materials as surrogates for field observation, a use that is increasingly widespread, most notably -- in a professional BBC context -- in connection with the

Open University in Great Britain. The "telephone" tape was made without formal script and shot in four hours, two of which were wasted because improper tape threading had lost us most of the material shot on the first try.

Appendix XI-A is a brief account of a more elaborate attempt at computer-aided production of materials suitable for use in mathematical instruction. This material was prepared as the culmination of an earlier line of technological investigation that ended in the early stages of the present project.

THE BRAIN, the on-line videographic computer system developed in the earlier project, was still in operation during the first year of Natural Sciences 130. Plans were therefore made to use it in a demonstration of Fourier analysis and synthesis for a lecture on basic principles of voice communications. Although a live demonstration over a two-way cable hook-up might have been a suitable alternative for the first year, the anticipated demise of the system prompted us to make a tape useable in subsequent years.

Appendix XI-B gives an account of the preparation of "Synthesis of a Sawtooth". Those interested in a more detailed analysis of the merits and demerits of this particular technique may wish to compare the accounts in Appendices XI-A and XI-B with the account of several different experiments using the same technology given by Hepner in his doctoral thesis cited in Appendix I-A.

The production of a more elaborately planned and executed tape on hermit crab communication is described in Appendix IX-C. While the telephone exchange tape was not edited at all and "Synthesis of a Sawtooth" was edited as a computer program prior to shooting, the crab tape was edited by the relatively primitive means available in half-inch and one-inch equipment. Editing was essential in this case: the tape was intended to illustrate in a compact way phenomena that could be observed in the laboratory or in the field only in much more time than could be spent on the matter in a survey course. The techniques developed by trial and error to cope with editing in "amateur" technology are described in Appendix IX-B.

By the summer of 1972 our course staff had acquired sufficient confidence to make field recordings at a five day conference on telecommunications and public policy. Two-camera techniques were used with results more interesting but no more expensive to shoot than one camera talking-head products. Excerpts from this material, listed on page 1 of Appendix II, were used both in class and as reference material by students in the 1972-73 edition of the course.

Discussions of instructional television production in the literature* tend to stress the use of facilities based on capital investments of $100,000 and up with insufficient emphasis on informal facilities costing $10,000 to $50,000 that can be assembled with half-inch or one-inch equipment. While the Carnegie Commission report cites one claim that "a simple television lecture can be produced for as little as $50 an hour" (page 95) - presumably by pointing a camera at a talking head -- others estimate $3,000, $6,000, $30,000 and up for producing one hour's worth of instructional television.

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* e.g., in To Improve Learning, Report by the Commission on Instructional Technology, in the report of the Committee on Telecommunications of the National Academy of Engineering entitled Communications Technology for Urban Improvement and in the Carnegie Commission on Higher Education's report The Fourth Revolution: Instructional Technology in Higher Education.

Our own experience supports the notion that the new half-inch and one-inch videotape technology together with super 8 mm and 16 mm film technology and incipient couplings of film and videotape technology provide a much richer spectrum of alternatives than hitherto noted in most discussions of motion picture materials for instruction. In terms of the range of possible capital investment, the range from amateur to professional status of production staff, the quality of materials, the intended scope of the audience, ephemerality or durability of materials, the options available now much more nearly approximate those now customary in writing technology. The scrawled note on the blackboard, the informally reproduced lecture notes circulated within a class or to colleagues in other classes or other institutions, the unpublished report literature, the stringently refereed and edited journal literature, textbooks, monographs, etc. illustrate the richness and variety available in writing media. Adherence to the one-professional-way of doing things in motion pictures no longer seems tenable. There is much fertile ground to be cultivated between the extremes of video-freak exhibitionism or aimless camera pointing for vague quasi-therapeutic or quasi-pedagogical purposes and professional productions costing many thousands of dollars per hour.

In order to stabilize the administration of video resources within our course and to lay the foundation for institutionalizing the experimental services developed in connection with the course, the process of proposing and evaluating videotape projects was formalized. Appendix IX-E shows forms developed for these purposes. The filled-out forms reproduced in Appendix X represent a sampling from our files.

D. Institutionalization

Appendix XI presents a series of vignettes illustrating several aspects of the institutionalization of videotape, broadband cable and conventional audiovisual technology within Harvard University. These are offered as additions to the scanty case literature on the subject. No attempt is made to interpret these vignettes within a broader analysis of institutional change, the sociology of organizations, etc. The story, in any case, is far from ended.

4. REMARKS AND RECOMMENDATIONS

Analysis of the three year record of Natural Sciences 130 reinforces certain themes developed in "Will Information Technologies Help Learning?" on the basis of the first year's record, the ongoing second year and the literature cited in that article:

1. The significance of diversity of learners, though vaunted in much of the literature, nonetheless is generally underestimated. In particular, the averaging out of differences significant to individuals may lead to no-significant-difference findings no matter how trivial or consequential effects on individuals might be in the laboratory or in the field. Moreover, our diary and student evaluation data reveal a wide variety of very significant impacts difficult, however, to correlate with or relate causally to "inputs".

2. Coming to terms with diversity raises issues that necessarily dominate pedagogical factors in educational policy making. There is, first of all, the question of balance between diversity -- the First Amendment tradition of the free marketplace of ideas -- and uniformity -- the state's concern for the socializing role of ideas. A consequent tension exists between the necessarily higher cost of tailoring learning goals, devices or processes to the individual and the economies of scale ensuing from adopting uniform goals, mass producing devices, standardizing processes and grouping learners.

Any attempt to serve diversity and efficiency by prior selection and optimal matching of learners, goals, processes etc. runs into our profound ignorance of how such matching might be done -- assuming that it is possible at all -- except in the clearest and simplest of circumstances and then only in the laboratory.

Our experience supports earlier observations that the alternative of leaving details of matching, even of matching to resources, to some market-like mechanism puts a severe strain on prevalent administrative processes. The vicissitudes to be met in mixed strategies are evident.

Is there any merit in continuing or replicating experiments like that reported here? We think the answer is a qualified "yes", with emphasis on the qualifications.

One important qualification follows from the following observation by Rothkopf:*

> "The records which schools usually keep of their deeds and their accomplishments are not well suited for the scientific analysis of teaching and the application of past experience to the future conduct of instruction. Records of instructional transactions as well as observations on students are incomplete and episodic and the interval between repeated presentation of a course may be weeks, months, and even years. Even if reasonable observations had been made it would not be easy to infer prescription for future action from events occurring so far apart in time without good records and convenient access to these. Furthermore, poor documentation in schools coupled with undue dependence on immature theoretical models has resulted in an overly abstract and arbitrary conception of learning and teaching. Record-keeping systems for schools such as course memories will tend to provide more tangible and realistic portrayals of instruction that will serve the researcher's intuition and provide practical aids for improving and maintaining instructional quality. Careful documentation of the instructional process over substantial periods of time is clearly needed for scientific studies of instruction and the rational management of courses."

Rothkopf goes on to describe what "course memories" should be like and notes numerous conceptual and logistical problems attendant on their development, especially when dealing with "unstable instructional systems such as lectures, casework and extemporaneous classroom discussion".

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* Ernst Z. Rothkopf, "A Proposal for Documenting Teaching Enterprises: Institutional Memories for Courses to Foster the Growth of Instructional Science and to Assure Instructional Quality", Unpublished Report, Bell Laboratories, Murray Hill, New Jersey, 1972, pp. 1-2.

Conceptual difficulties can readily be imagined. The logistical difficulties flow from the fact that, whatever the conceptual details, gathering, updating and exploiting a course memory is a major and (if it is to be useful at all) protracted undertaking. We have noted throughout this report instances of our inability to cope with even a rudimentary course memory within the confines of an isolated experiment.

The management of course memories, the instrumentation for measurement and evaluation of benefits, the accounting necessary to track and project costs, the coordination of conventional and specialized resources, the diffusion and consolidation of promising results from research to development to routine use, are all matters that can be dealt with effectively at no less than an institutional scale. Numerous issues noted in "Will Information Technologies Help Learning?" transcend the institutional scale.

Yet we persist in "intervention experiments", to use a currently fashionable phrase, that sail the seas alone. We fail to draw more than lip-service conclusions from the repeated observation that the waves swallow up these experiments as soon as heroic measures have grown tiresome and new fads swell elsewhere.

In preceding sections we noted the unfortunate absence of various baseline and comparative data, and also the fortunate coincidence between certain needs of ours and certain purposes of the Office of Tests of our Faculty of Arts and Sciences. In March, 1973, that office was absorbed into a newly created Office of Instructional Research and Evaluation.

In announcing the new office, the president of the university described it as intended to "assist the administration, departments, committees and houses in evaluating the effects of their educational programs". He noted that "Universities have done very little to gain systematic knowledge of the instructional and ethical impact of courses, concentrations or liberal education in general, and this includes Harvard. My hope is that research in these areas will give us data to know what effect instructional practices can and do have on our students and to give us a better way of making tough decisions about education."*

More such steps must be taken and orchestrated. The allocation and management of every human and capital resource of an educational institution must be harmonized if worthwhile changes in instructional technology are to be identified and moved effectively from conception to experiment to development to routine use. In addition, institutional objectives can neither be framed coherently let alone attained without close integration with developments in industry and with public policy on such matters as copyright legislation, library management and finance, cable television, etc.

Obvious as such remarks may seem, their implications do not appear to have been taken explicitly into account in recommendations such as those made by the Carnegie Commission.** The following Carnegie recommendations, however necessary their adoption might be, are neither entirely on the mark nor likely to be sufficient in the light of our findings:

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* Harvard University Gazette, Vol. 68, No. 24, March 9, 1973.

** The Carnegie Commission on Higher Education, The Fourth Revolution: Instructional Technology in Higher Education, McGraw Hill, New York, 1972.

> "Recommendation 3: Institutions of higher education should contribute to the advancement of instructional technology not only by giving favorable consideration to expanding its use, whenever such use is appropriate, but also by placing responsibility for its introduction and utilization at the highest possible level of academic administration.
>
> Recommendation 6: By 1992, at least seven cooperative learning-technology centers, voluntarily organized on a regional basis by participating higher educational institutions and systems should be established for the purpose of sharing costs and facilities for the accelerated development and utilization of instructional technology in higher education.
>
> Recommendation 15: An independent commission, supported either by an appropriate agency of the United States Department of Health, Education and Welfare or by one or more private foundations should be created to make assessments of the instructional effectiveness and cost benefits of currently available instructional technology. Findings of the commission should be published and appropriately disseminated for the advice of institutions of higher education, such cooperative learning-technology centers as may be established, and governments and foundations supporting the advancement of instructional technology.

The text leading up to Recommendation 3 does speak of "mobilizing their institution's total instructional resources" (p. 50) but does not call attention to the need to:

1. Develop accounting procedures capable of providing baseline costs for current procedures in a manner useful for projections and for eventual comparison with changed practices;

2. Provide a realistic managerial and structural context as, for example, by introducing market-like procedures to help in measuring and allocating the use of instructional resources;

3. Provide for the development of "course memory" procedures that might permit longitudinal measurements and cross-comparisons of effectiveness.

Meeting these needs for a single course is economically impractical. A further implication is therefore a commitment to experimentation on a large scale if at all. The alternative is a more informal laissez-faire or Darwinian outlook. The middle ground of formal small-scale experiments seems untenable.

The cooperative learning centers envisaged in Recommendation 6 are to give "participating institutions the benefits of spreading costs of constructing and acquiring expensive mediaware and facilities among many users" (p. 53). They should identify, produce and distribute already developed teaching and learning materials, make available centralized computing, information and large-scale production facilities; be regional clearinghouses; provide professional expertise; and "serve as another link between faculty members who have developed promising instructional materials and government, foundations and industry" (p. 56).

The emphasis on materials and services does not sufficiently stress the likelihood that the most significant problems and also the greatest opportunities in exploiting instructional technologies will have an economic, managerial and structural flavor. The procedures outlined respecting Recommendation 3 are of equal importance, on an inter-institutional scale, to learning-technology centers. Support to participating institutions in developing suitable instrumentation for cost and benefit measurements, distillation of common elements of managerial issues, aggregation of market demands vis-a-vis industry, etc. deserve greater emphasis.

In the absence of such procedures, experiments conducted within the framework envisaged by the Carnegie Commission are likely to continue as fragmented, as incoherent and as difficult to interpret as at present. The "assessments of the instructional effectiveness and cost benefits of currently available instructional technology" envisaged in Recommendation 15 now have little scientific to go on. Expressions of administrative or political will are not likely to stand on a stronger *scientific* foundation in the future nor is it likely that there will be an improvement in our *scientific* understanding of how better to adapt institutional structures to desired ends unless future experimentation is carried out with greater coherence, on at least an institutional scale and with extensive instrumentation that reaches not only into conventional measurements of learning but at least into economic, managerial and structural effects as well. Quite possibly even then and certainly otherwise, the trappings of science risk impeding the practice of art and engineering and blurring lay judgments on the critical balance between diversity and uniformity.

Anthony G. Oettinger

AGO:cmb

APPENDIX I

PRINT PUBLICATIONS AND VIDEOTAPES

APPENDIX I-A

LISTING OF PRINT PUBLICATIONS AND VIDEOTAPES

Oettinger, A. G. and N. Zapol, "Will Information Technologies Help Learning?" Teachers College Record, Vol. 74, No. 1, September 1972, pp. 5-54; also in Kaysen, C. (editor) Content and Context: Essays on College Education, McGraw-Hill, New York (in press).

Hepner, M. P., Technology and the Hidden Curriculum, Doctoral Thesis, Harvard University, Graduate School of Arts and Sciences, May 1972.

Zellweger, A. G., An Investigation of Some Critical Factors in Educational Technology, Doctoral Thesis, Harvard University, Graduate School of Arts and Sciences, April 1971.

DesMaisons, R. E., M. P. Hepner, R. J. Dirkman, "THE BRAIN System" in Computers in Undergraduate Science Education, Commission on College Physics, College Park, Maryland, 1971, pp. 121-135.

Oettinger, A. G., "How to Make Dreams Come True", in Computers in Undergraduate Science Education, College Park, Maryland, 1971, pp. 435-444.

DesMaisons, R. E., "On-Line Videographic Output", UAIDE Proceedings, No. 9, Miami Beach, Florida, October 1970, pp. 379-380.

Rosenbaum, S. M., Computer Simulation for High School Students, Doctoral Thesis, Harvard University, Graduate School of Education, July 1970.

Videotapes Made for NS 130

Hermit Crab Communication

Field and laboratory shots of hermit crabs. Illustrates leg raises, etc., used as signalling devices by hermit crabs. Introduces information-theoretic analysis of crab communication patterns and role of these patterns in preserving the species. (Shown in '71, '72)

Computer Display of Hermit Crabs

Stylized computer-animated displays of signals shown in Hermit Crab Communication. Originally made as back-up against failure of live computer demonstration presented via video link. Since program no longer available, now serves as sole source. (Shown in '71, '72)

A Walk Through the Telephone System

Illustrates path of a telephone call from sender to receiver through a local electronic office (ESS-1), as surrogate for impractical field observation. Now suitable for coordination with articles in September 1972 Scientific American, especially those on "Communication Networks". (Shown in '70, '71, '72)

Moments

Excerpts from tapes made by students in N.S. 130 in 1971-72. Illustrates range of quality of amateur products, as comparable with distribution of quality of written student papers. Half-inch and one-inch equipment used. (Shown in '72)

Fourier Synthesis

Computer-generated animated illustration of Fourier synthesis of sawtooth wave. As substitute for live computer display, serves to introduce concepts of bandwidth, linearity, etc. (Shown in '70, '71, '72).

Interviews with Conductors

Adjunct to live lecture illustrating variations in expressive styles of different conductors. (Shown in '72)

Computers - How They Work

Adjunct to live lecture on computer principles - back-up to live teletype demonstration. (Shown in '72)

Institute on Telecommunications and Public Policy, Harvard University

Sessions of July 13-18, 1972 videotaped in their entirety. The following segments used in N.S. 130:

Paul Klein, President, Computer Television, Inc.

Peter Goldmark, President and Director of Research, Goldmark Communications Corp.

Richard Hooper, Senior BBC TV Producer, Faculty of Educational Studies, The Open University.

(Shown in '72)

Slide/Sound Presentation Made for N. S. 130, Introduction to Information Theory - The Bit

A brief introduction to the bit as a measure of selection of one from among 2" alternatives. (Shown in '72)

Other

Display Formatting Techniques (Videotape and 16 mm film). Illustration of methods for formatting displays in THE BRAIN computer system and the philosophy behind their design and implementation.

Communication Theory (16 mm film) Animation introducing concepts of Shannon's model of path from sender to receiver (Shown in '72).

Non-published Presentations at:

1. On-Line Users' Conference, University of California, Los Angeles, 1970
2. Biology-Chemistry-Physics Workshop, University of North Carolina at Greensboro, March, 1971.

APPENDIX I-B

Review

of

"Will Information Technologies Help Learning?"

I-B-1

educational technology reviews

Commentary on "Will Information Technologies Help Learning?"

By Anthony G. Oettinger and Nikki Zapol.
Teachers College Record, Fall, 1972.

Charles A. Wedemeyer

(The essay reviewed here was prepared for inclusion in a volume on the undergraduate curriculum and instruction, edited by Carl Kaysen, to be published by the Carnegie Commission on Higher Education and the McGraw Hill Book Company. The essay, as reviewed, was published in the *Teacher's College Record*, Columbia University, Fall, 1972. Anthony G. Oettinger and Nikki Zapol are at Harvard University.)

This essay is a significant contribution to the literature on technology in education. The piece brings together for critical analysis almost all of the diverse and complex elements that affect the adoption and the operation of learning systems that are dependent upon technology for their effectiveness. The authors of the essay limit themselves (as indicated by their title) to information technologies. This term seems to mean almost the same thing as the "new educational technologies" that "mediate" between the learner and the materials for learning. Oettinger and Zapol presumably would also identify the teacher as mediator since the teacher stands between the learner and the materials of instruction, whether the teacher is face-to-face or mediating for a distant learner.

The aim of the essay is to clarify the impact of technology on learning, and to illuminate the forces that lie behind technological impact "so that informed citizens may participate more fully in guiding the coherent evolution of the nation's strategic resources for learning."

The authors point out early in the essay that "There is growing realization that it is hard to perceive learning needs adequately, hard to assess the value of technology for learning, and hard to deploy people, processes and tools effectively." They point out that the pace of decision-making is accelerating rapidly, that decisions critical for learning resource development are being made perhaps unwittingly in industries (entertainment and telecommunications primarily), and that the government regulatory agencies involved in such decisions are not those that have a primary concern for learning. Hence the authors present a compelling case, throughout the essay, for larger citizen participation in the determination of priority in the direction of educational development in the United States as a counter to the present situation in which priority decisions are made primarily by those who have special interests outside education.

Broad Range of Topics

The essay treats in brief but satisfactory fashion a broad range of related topics: Learning and the Media of Social Memory, Technology and Evolution of the Universities, Public Access to Distribution: The Postal Service and CATV; Content and Markets: Issues in Publishing; Access to Storage: The Library Crisis; Personal Contributions to Memory: Rights and Limitations; and Piracy and Fair Use: The Copying Technology and the Law. The paper's chief value is that it provides insights into the complex interrelationships of many factors working together to determine the employment of technology for learning. To the experienced innovator in the field of educational technology, there is nothing really new in the essay. However, the orchestration of all of the elements that affect the adoption of technology in education is a significant contribution. To those whose hostility or inertia to technology has kept them ignorant of what is going on, the essay will be a sharp reminder of their obligation to be more concerned. To all readers, the essay is a veritable gold mine of ideas, information, examples, muted wit, insight and suggestion. The authors have piled observation upon observation relentlessly to expose the present narrow, parochial and self-serving bases for most decision-making with respect to the development of a learning technology, and find in this wholly inadequate developmental milieu the basis for their observation that it is by no means self-evident that technology can serve learning at all.

It is important that the reader perceive that Oettinger and Zapol are not saying that technology could not serve learning, but rather that the extraordinarily complex and diffused means for decision-making in technology raise doubt that learning technologies of any great significance can properly develop. It seems clear that Oettinger and Zapol have faith in the efficacy of learning technologies for the solution of educational problems, and for the freeing of the learner from the constraints of conventional education.

Counterproductive Elements

The debilitating elements that are counterproductive in establishing and employing learning technologies are rooted in areas outside the direct influence of teachers and learners: in an economic situation which encourages go and no-go decisions on the basis of competition for profit; in traditions of nongovernment interference even in areas in which the public good confronts the narrower objectives of business and industry; in the lack of rationally developed federal policies for the development of communication and information systems; in conflicting traditions and ideologies respecting the communication of information and entertainment; in complex problems of storage, distribution and retrieval of things and information; and in the impact of technology itself on the industries and processes that supply information to the American people. The scope of the essay is so broad, and the authors juggle so many balls at one time, that the reader will probably be dazzled.

The "vicious inter-locking circles" that the authors refer to in their exposition of the complexities of decision-making in the area of information technologies produce a familiar pattern of lament: "For want of storage and distribution facilities, learners will not be reached; for want of learners, learning material will not be produced or criticized; for want of high-quality learning materials, learners will not learn; and, for lack of demand, storage and distribution facilities will not be established." Substitute in place of storage and distribution facilities almost any of the other problems iterated by the authors, and a similar circular lament can be constructed. These interlocking circles preclude entrance of the educator with rational plans for the improvement of learning. Foreclosed by tradition, custom and governmental process from entry into a circularity of events determined by forces beyond his power to influence, the educator seems to be powerless to affect the development of adequate technologies for learning. It is this viewpoint that gives the essay its somewhat negative tone regarding the ultimate contribution that information technologies will make to learning.

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A Concept of Learning

One of the continuing threads in the Oettinger-Zapol essay is the authors' concept of learning itself. Readers from either the mechanistic or the organismic schools may be frustrated by the vastness of the vacuum which surrounds the authors' discussion of learning. Early in the essay, the authors point out that the sweep of issues included would simply be unmanageable if something were not left out. Nevertheless many readers, while delighted with the sweep of the essay, will note with some dismay the lack of treatment in depth of subjects (like "learning") that may be more essential to the thesis of the essay than the authors imply.

The authors point out that they are emphasizing "learning based on symbolic information, hence on technologies serving as vehicles for linguistic or pictorial symbols. The world itself, the people in it, and their symbolic records together embody the social memory which is the foundation of learning." The scope of the essay, therefore, is restricted to those artifacts and institutions "which embody and articulate the symbolic portion of this social memory." By learning, the authors mean "partaking of the social memory," something which the authors see as a continuing act throughout life, and not at all restricted to the formal education in which the person is a participant. It is clear that the authors do not conceive of the social memory as being static and fixed; indeed, the authors are properly concerned with the individual's rights and opportunities not only to draw from this store of social memory but to contribute in an idiosyncratic way to that store.

In abstracting the whole complex of learning into the symbolic "partaking of the social memory," the authors have sidestepped any direct need to deal with the disparate elements that make up learning. Hence we find almost no discussion of familiar topics such as meeting learner goals, equalizing opportunity by breaking the space-time requirements characteristic of conventional learning, motivation, relevance, new roles for teachers, systems design in the development of mediated programs, market surveys for the location of learner populations, budgeting for instructional and media/technology servicing, or the conceptualizing of new instructional patterns and institutions. All of these (and others) are subsumed in order that the authors may produce a grand sweep. It is no doubt inevitable that some readers will feel that, in subsuming any element, the authors may inadvertently have suppressed a vital factor.

A Different Context

While the experienced educational innovator and those who work with the application of new technologies to education will find all of the subject matter in the essay familiar, the context which the authors provide is different. It is as though the authors are viewing the struggle to improve learning from a geo-stationary weather satellite. They note the swirls of movement and counter-movement, the sharp confrontations of one front with another, the interlocking pressure ridges that constitute the structure for weather at any particular point. The analogy may be apt; the grand sweep, the global view taken by the authors, yields up to the reader an awesome complexity of force and counter-force—more a picture of climate with respect to the introduction and maintenance of technologies for learning than the details of the specific environment faced by individual actors in the drama that unfolds. Hence the learner, the teacher, the parent, the school administrator, the boards, commissions and agencies of which we normally think in assessing the direction and control of the educational enterprise are not visible here. Indeed, from this viewpoint the reader perceives that the central actors (learner, teacher, parent, etc.) may be the pawns of larger forces, outside the concerns of education, which are responsible for many of the irrational constraints which inhibit orderly educational development. A reaction of something like helpless outrage may suffuse the concerned reader as he senses the degree to which he may cut off from meaningful impact on forces which determ educational direction.

"No-Significant-Difference" Syndrome

In their discussion of the no-significant-difference syndror the authors make a number of observations which are useful a important. They point out that the no-significant-differer findings "confirm the limitations of formal research on learn rather than deny the impact of technology on learning." They aware that significant differences are yielded in different proaches, in outcomes or correlates of learning other than th measured by conventional test instruments. They quite prope point out that the no-significant-difference syndrome ha positive consequence: that "learning is largely independent of detail of means, hence the issues of technology and policy on one hand and of learning method and content on the other essentially independent." The no-significant-difference findi imply wide-open alternatives to conventional schooling for achievement of important educational goals. It is regrettable t the authors were not able to pursue further their otherw excellent discussion. The importance of the no-significant-dif ence findings to long-held objectives for the equalization educational opportunities for all persons, which can now achieved through the use of technology in education, ne specific follow-up. The follow-up, however, will have to supplied by the reader himself.

Another possibility which arises from the authors' treatm of the no-significant-difference syndrome is that the research r be right after all. It is hard for educators who feel person identified with the particular method or approach which they and find comfort in to perceive that the particular metho approach might not actually make any difference in term measured learnings. This seems so monstrous a suggestion th is dismissed as evidence of poor research, poor instruments inadequate methodology. The possibility rarely occurs to any that perhaps the research is right, and that maybe it doesn't re make any difference how the learner is taught.

While such a possibility seems to denigrate the importa of the teacher's methodology, it also implies *an elevation of learner to the central point in the teaching-learning proc* something which progressive theories of education have l demanded. What if, for example, the computer known as human brain is so sensitive, so adaptable, so vast in its capacit cope and adapt to the problems of the individual, that it "learn" with relatively the same efficiency from almost method or approach? If this is true, then a number of mystic about teaching and learning must fall. The authors do follow-up their discussion on no-significant-difference to sp late regarding the impact of such a proposition.

A Viable Economy for Educational Technology

In their treatment of the forces and counter-forces lar outside the domain of the educational actors the authors have overlooked another significant factor in the creatio educational markets, a viable economy for educational tech ogy and the solution of storage and dissemination probl Market, economics, storage and dissemination are considere the authors from the point of view of a social model which an active role to persons outside education and forces a rea role upon those concerned with and inside education. Howev the full import of the meaning of the no-significant-differ syndrome is in the direction hypothesized, and if the educati segment of society were to perceive this implication, then social model might be affected significantly enough to pro educators an active role in bringing about sweeping change i employment of technology. Obviously this is purely specula and the authors confined themselves to pragmatic observatio e social model as it operates without a significant input from ucators.

Quite rightly the authors point out that the content of arning doesn't necessarily determine the choice that teachers ake between available media. Inasmuch as learning research o-significant-difference syndrome) doesn't either, the authors ggest that we must look for more fundamental factors which ould enable public policy to seize control over the direction in hich technology is developed with respect to education and arning. The factors which the authors suggest "derive from the ed to balance preference for economy against individual choice d related issues of control over media for learning." We then nfront the familiar questions: Who is to have access? Who is to ntrol? What will the cost be to users (learners)? Who will bear e cost? These are the major policy issues, the authors point out, at will very likely be resolved by forces outside education and blic policy—the entertainment industry, the information tech- logy industry, the public regulatory bodies which do not have a sponsibility for education although they shape the climate and vironment for the development of technologies which have levance to learning, and the political process which is responsive special interests.

New Climate for Learning?

The issues so neatly categorized are primarily philosophical ues. The pragmatic approach that the authors have used cludes consideration of the possibilities of philosophical change termining a new climate or environment for learning. Yet in the st several years we have witnessed some sweeping changes in blic policy which resulted from a ground swell of philosophical ange with respect to certain problems. Could this happen with spect to technology in education? The authors do not address e question directly. We can applaud their hope that we can ep strategy and discussion-making out of the hands of f-serving interests so that learning policy can be determined in e public interest. They may be right that the teacher, learner d parent do not have a central role in our process for veloping learning priorities and strategies.

The authors point out that the Open University of Great itain has feasibility because it is grafted onto the facilities of e BBC and the post office, making it possible for the Open niversity to achieve a viable scale of operations—although e-third of the Open University budget does go to the BBC. The pen University is not getting a free ride. In the process of eveloping the British Open University, we see an example of hat happens when priority and strategy are placed in the hands a responsible group not acting to protect self-interests. In itain the government supports all of education, owns the BBC d the post office, and can deal with the means of learning apart om matters of content and the special interests of suppliers of chnology. It would have been useful to have a fuller explana- on of the Open University situation so that the reader nfamiliar with Dr. Walter Perry's *The Early Development of the pen University*, would perceive in what ways the arrangement r the developments of the Open University fit the conditions uggested by the authors for bringing the control of the evelopment of information technologies, in this country, into e area of public policy and concern.

The authors refer to Jack Arbolino's proposed national niversity, which would have the authority to grant degrees on e submission of evidence of achievement from a diversity of urces. The Minnesota Metro State College might well have been ited as an example already in operation and empowered to grant egrees as indicated.

The discussion of "self discipline" as a requirement for uccess in open education programs contrasts the Australian utback with New York City or London, and raises the question f whether people really can be isolated learners, and the number of learners there are who have the self discipline required for learning in an open education system. The authors suggest that open education appeals to a fairly narrow range of learners, and imply that telecommunications may not be able to complement or replace the normal face-to-face interactions which are found in conventional schools. The lack of a large clientele would make it difficult to achieve an economically attractive base for innovative and alternative approaches to education. To this reader the reference to face-to-face interactions above seems naive; "face-to-face" hardly exists anymore in the conventional undergraduate university, and has been identified by dissident learners as one of the growing problems of conventional education.

The Telecommunications Technologies

The authors make no reference to the pilot tests which proceeded the establishment of the Open University in Britain and elsewhere, and to the primary literature of the experimental period. Nor do they refer to the very considerable literature in this country and elsewhere which indicates that there are independent, distant learners in fairly substantial numbers throughout society, and that perhaps the reason that independent study systems (such as correspondence study) have heretofore dealt with a relatively small proportion of learners is not that the learners lack self discipline but that the media used (in this case printed and written materials) screen out only that portion of the population which is print- and writing-oriented. If this is so, then the role of the telecommunications technologies in learning is much larger, and significantly different from, that ordinarily perceived for it. There seems to be ample evidence that telecommunications technologies linked with print and writing technologies can quite successfully compensate for the lack of face-to-face relationship that characterizes much of conventional education.

The authors point out that "Telecommunications offers an alternative to physical transportation of people or symbolic vehicles," but they point out that presently the most significant means of bringing the store to the learner are radio and television, because CATV is still in its infancy and the telephone has had little impact. As generalizations these statements are true, but it ought to be noted that there is substantial use of the telephone in certain projects of great promise. For example, the Educational Telephone Network of the University of Wisconsin-Extension in 1971-72 served nearly 20,000 students registered for course work via the telephone. This is not an insignificant number; in fact, it begins to approach the aggregation level or critical mass requirements of, for example, the Open University of Great Britain.

A Complex Problem

How technology can help learning turns out, in the Oettinger-Zapol essay, to be a far more complex problem than most persons realize. The authors have clearly indicated that, only with unfettered and economical access to the means for distributing information, can public and private patterns of mediating learning evolve. Otherwise, the potential of technology helping learning in a democratic society is doubtful.

The essay is salutary in that the authors have clearly demonstrated that the onus for a lagging use of technology in education in the U.S.A. is not solely the intransigence of educators, but is primarily the result of archaic traditions and regulations which tend to perceive the public good in terms of property rights over other considerations.

Experienced innovators in instructional telecommunications will breathe a hearty "amen" to the statement, "The public need for access to telecommunications for learning is too important to be left caught in the glacial inertia of established educational institutions, the opaque politics of common carrier regulation, and the frenzied commercialism of the mass media tradition." ☐

APPENDIX I-C

Synopsis and Conclusions

of

"Technology and the Hidden Curriculum"

SYNOPSIS

This dissertation develops a coherent framework from which to examine the effectiveness of educational technology. The framework consists of a theoretical model of (1) interrelationships between institutional variables and student learning, and (2) the role of educational technology in shaping the nature of these relationships.

Chapter II examines various existing conceptual models of learning and proposes an original model: the hidden curriculum model. The latter relates various roles and procedures as embodied in a schooling institution to the hidden curriculum or meaning that a student derives from his school experience.

Chapter III analyzes several curriculum projects and finds that they differ according to the roles and procedures that they try to establish in relating students, teacher and information resources. A curriculum, then, is a particular prescription of roles and procedures as embodied in a curriculum project. Chapter IV examines the widely differing results of a single curriculum used in various institutional settings. These results are accounted for in terms of how the curricular roles and procedures fit into the other institutional roles and procedures.

Chapters V and VI consider educational technology. A technology, like a curriculum, is a particular prescription of roles and procedures as embodied in devices or tools. Detailed, personal accounts of successes and failures encountered from using a single technology in several settings are once more explained by the hidden curriculum model.

Chapter VII reviews and extends the implications of the model for the possibilities and limitations of educational technology.

CHAPTER VII

CONCLUSIONS

The explosion of educational innovation since the late 1950's has failed to achieve even a fraction of its expectations. New curriculum projects have been designed and resources and devices either created or adapted from existing ones to meet various educational purposes. But even where the curriculum projects, resources or devices have managed to survive in the schools the results have been an overwhelming "no significant difference." The question addressed in this thesis is why. The explanation we have put forward emerges from our analysis of relationships, not previously understood by the innovators, between classroom resources and learning.

There is no straightforward, one to one correspondence between curriculum projects or resources and leaning. Simple input-output relations do not hold. Learning goes on in the student's mind; it may be influenced by resources but in complex ways determined by many factors of past and present experiences which shape each student's mental map. We cannot look into students' minds, but we have singled out for analysis those factors of the school institution which we believe have a strong influence on a student's mental map. These factors comprise what we have called the reward structure. Limiting ourselves to intra-institutional factors was necessary for keeping this discussion within reasonable limits and justifiable as long as we remain conscious of the implications of this limitation for what we say about learning.

The institutional reward structure is made up of tangible rewards received by the student, attitudes communicated by teachers and administrators and relations sanctioned by the institution among students and between students and adults. The reward structure is shaped by particular roles, procedures and relationships. We have limited the range of our discussion by analyzing only a few of these shaping forces that seem most significant. Those considered were: the four chief constraints common to almost all schools; multiple pressures of the institution on students and teachers alike; and those roles, procedures and relations that produce a sensation of conflict and dissonance in students and/or teachers.

An institution or a classroom in an institution can be seen as a bundle of roles, procedures and relationships. Learning can be seen as the adaptation to this environment with its demands and rewards. Educational critics such as Holt, Dennison, Friedenberg, Goodman, et al. have long emphasized the importance of the school environment and singled out for blame aspects of the reward structure such as certain tangible rewards, or particular kinds of student interpersonal relations, etc. Unfortunately, by not proposing any coherent picture of the interrelationships of such procedures, roles, attitudes and relations, as in an overall reward structure, they have greatly reduced the effectiveness of their arguments. Noticeably absent from their considerations has been a recognition of the influence on these roles and procedures coming from the primary focus for innovation in the schools: curriculum projects and educational resources.

Just as unfortunately, curriculum reformers and educational designers have had little concern for even isolated features of the reward structure, let alone a coherent picture. Their efforts have been toward bringing to the schools a new method or procedure or, more often, an updated subject matter or a new resource simply for its own sake; i.e., as an input.

Once again, an institution or a classroom in an institution can be seen as a bundle of roles, procedures and relationships. Technology (or equivalently curriculum) embodies some of these roles, procedures and relationships. It is a falacy to think of resources as inputs capable, in and of themselves, of effecting particular educational outcomes. Every resource in a school is a part of a technology. Every technology in a school that is embodied in a resource is but one small part of the total institutional set of roles, procedures and relations.

The main thrust of this thesis is that to understand technology in terms of effects on learning, one must understand the place of the technology in the total reward structure of roles, procedures and relations. We have seen in the case of my own experiment that a single technology based on a single resource achieved excellent results in two settings but failed outright in another. Such results are inexplicable in terms of an input model of the impact of technology on learning. With the hidden cirriculum model, a consistent and illuminating analysis obtains.

Our evidence suggests that a new resource will be used in the classroom if the resulting technology is consonant with existing roles and procedures, or can be reshaped (or distorted) until it is consonant. A technology that is dissonant and rigidly resistant to change is very likely to be abandoned. But to develop a technology that is consonant with classroom procedures is a difficult undertaking. For example, the many months of planning for the brief and unsuccessful classroom use of the computer technology in our experimental effort reported in Chapter VI reflects a large expenditure of time, money and effort.

A recent unpublished report, prepared for the Commission on Instructional Technology (Hooper, 135) surveying some of the best known multi-media projects in this country stresses the need for support from everyone in the institution, administrators and faculty alike, just to overcome the inevitable and numerous factors of dissonance arising from introducing something new. Without such prior arrangements for supportive organization, projects inevitably failed. Effort by a single individual is enough only if it leads to support from the whole institution. And in the end, as the Commisssion report itself nicely confirms, with support aligned behind the technology to smooth its way by eliminating dissonance, but with the reward structure unchanged, the result is "no significant difference."

If, with considerable effort, a technology is made consonant with the existing institutional roles and procedures, our empirical evidence suggests that the innovation will result in "no significant difference" in learning achievement but also in a possible improvement in efficiency. This makes theoretical sense from our hidden curriculum model: consonance between a technology and the reward structure implies that no significant change in the reward structure will occur and therefore no significant change in learning.

Our evidence further suggests that improvements in learning achievement are possible when the institutional reward structure is altered. This was the case in the Army Special Training Units and job training with employment opportunities. However, the role of new technology for such changes was quite limited. Alterations of the reward structure occurred primarily by changing institutional roles, procedures and relations embodied elsewhere than in the new resources or devices.

It follows that a new technology may have an impact on learning achievement when it accompanies appropriate changes in the reward structure. Improvements may follow, but there is no guarantee: there are too many factors outside the classroom, factors not considered in this thesis but very powerful in their effects, that also influence the mental map of students.

Neglect of the role of extra-institutional factors points to one limitation of our model. School is not the student's whole world. Attitudes, relations, values and expectations of parents, community, peers, etc., have shaped the student long before he ever entered a school and continue to do so concurrent with his schooling. It is conceivable, in many instances, that these forces outside the school (and outside this analysis) may be so strong as to completely outweigh anything that happens inside the school.

A second limitation of our model arises from not having considered individual variations among teachers. The individual teacher's personality, his or her interest in the students and willingness to experiment and innovate may well account for the successful use of a resource where an analysis of the interrelations between the technology and normal roles and procedures of the institution would indicate dissonance and failure. In fact, a capable teacher willing to compensate for poorly designed resources, embodying nearly untenable roles, with his or her own time, money and energy can do quite well - at a large personal expense. But our concern is not with such anomalous accounts of successes attributable to heroic individual efforts. Such efforts, no matter how commendable, represent too isolated a phenomenon to be counted on for any sustained educational changes. When a reward structure is solidly embodied in an institution, it is probable that the individual will give in before the institution.

The reward structure, then, is basic to learning - a conclusion that leaves very limited scope to educational reform through new resources and devices. The question is, "is there any scope". My own experiment indicates that there may be. Given the very different reward structure of my individual work with THE BRAIN, as compared to the classroom use, was my experience in learning statistics qualitatively different from experience I would have had using traditional text books? I think so. I doubt if I would have made the same discoveries in this setting without the computer technology or its equivalent. The nature of the technology as embodied in the computer resource was, I think, important for the learning that took place. However, and this I must stress, the focus of curriculum reformers and innovators has been almost solely on the specification of particular resources and devices for learning outcomes. Such specification, without consideration of institutional reward structures, bears the mark of a shortsighted, input/output approach. THE BRAIN technology was significant for me; but its significance was determined by the whole institutional reward structure. And it is the latter that severely limits the scope of technological change.

Where do we go from here? There is a serious theoretical difficulty; namely, how to measure achievement over both short and long terms. Standardized tests are highly controversial measures of learning that takes place over relatively short periods of time. There is no measure of the effects of long term adaptation of a particular student to a particular reward structure. We have obviously not solved this problem, but in a few areas of considerable practical importance, we can sidestep it. We can identify dropouts and determine illiteracy. And maybe this is a good place to focus some attention: considering the recalcitrance of the dropout and illiteracy problems, alterations in the institutional reward structure that would improve these situations may just prove to be alterations that improve learning over the long term in other ways as well.

Practically speaking, what can we do? A suggestion is that energies and funds be diverted from invention of more curricula, resources and devices to analyses, more likely to be profitable in light of the approach in this thesis, of what we already have in institutions. Every school already has curriculum projects and therefore curricula, resources and therefore technologies. Much of the expense and effort in schools in trying to smooth the way for innovations has been expended without any consideration for its existing technologies. By analyzing the institution and its curricula and technologies, we might discover what the working reward structure (often well hidden behind administrator's rhetoric) really is.

Revealing the reward structure could lead to possibly changing it or, minimally, to reducing dissonances within it. If through such an analysis, we came to better understand the nature of institutions and technologies and also what it takes intellectually and emotionally for students to take part in school institutions, then we would be in a better position to explore the avenues that are really open for change.

APPENDIX II

Natural Sciences 130

Course Materials for Students

1972-73

Natural Sciences 130. Communication in Societies

Professors William H. Bossert and Anthony G. Oettinger

An exploration of the science and technology of communication among men, animals, and machines, and of its effects on social organization. Human speech, writing, and art and various examples of animal communication serve to introduce a scientific analysis of the fundamental characteristics of communication systems and of their role in organizing societies. Contemporary problems attendant to the rapid spread of telecommunications and computers are analyzed to shed light on the interactions between information processing technology and society. The course itself is an experiment in communication through various new forms of educational technology.

Note: Distinguished performance in this course is prerequisite to enrollment in Natural Sciences 131. *Enrollment*: Limited to 75.

Half course (fall term). Tu., Th., 2–3:30. 2069 (XVI, XVII)

COURSE APPLICATION

Natural Sciences 130

September 1972

Name ______________________________ Class __________

Field of Concentration ______________________________ Sex __________

What made you come to this lecture today?

☐ Course catalog
☐ A friend
☐ Professor, lecturer, etc.
☐ Configuide
☐ You got swept up by the crowd
☐ Other. Explain ______________________________

Background

Number of years of science in ____ high school. Of math in ____ high school.
____ college ____ college

May we look at your Harvard record to get a better profile?

Sketch any previous experience with videotape, audiotape, sound-slide, lightshows, computers, film ....

Would you say that for the most part, your education has been traditional? Experimental? Progressive? Liberal? or what have you?

Communication

On the spectrum between neo-Luddites and technology worshippers, where are you? (If you dream of taking an axe to a computer, you're a n-L.)

Do you plan to take this course? Why or why not?

If you do, will you take it pass-fail or graded? Why?

For fun, do you want to define communication? Go ahead (or don't).

Natural Sciences 130

(9/26/72)

Schedule - Fall 1972

ues.	Thurs.	WHB	AGO	RL	DP	PB	NZ		
ept 26			x					Course Introduction	
	Sept 28	x						Shannon's Theory of Information ...	
ct 3		x						... applied to Hermit Crabs	
	Oct 5			x				Non-verbal communication I	
ct 10			x					The Scientific and Technological ...	
	Oct 12		x					... Foundation of Telecommunications	
ct 17				x				Demonstrations: Fundamentals of Electrical Communications	Pierce 110
	Oct 19		x					Introduction to Information Technologies and Public Policy	
ct 24							x	Educational Technology in Developing Countries	
	Oct 26					x		Non-Verbal Communication - Music	Sanders
ct 31				x				Non-Verbal Communication - II	
	Nov 2		x					Broadcast and Cable Television	
ov 7					x			Cable Television Regulation - A Case Study	
	Nov 9					x		Computers	
ov 14						x		Computers	
	Nov 16		x					Information Technology & Public Policy	
ov 21			x					Information Technology & Public Policy	
ov 28			x					Information Technology & Public Policy	
	Nov 30	x						Animal Communications - Richness & Variety	
ec 5		x						Animal Comm. - Food Gathering by Ants	
	Dec 7			x				The Theater	Loeb
ec 12				GUEST				Data Banks in a Free Society ...	
	Dec 14			GUEST				... Privacy and Due Process	
ec 19			x					Language and Linguistics	

ng Period: Jan. 4, 9, 11: Reserved for student project presentations.

REQUIRED ASSIGNMENTS SCHEDULE

	Tues.	Thurs.	Goldmark Tape	5-Min Video	Project	Diaries
4		Oct 5				
5	Oct 10			Fri-Oct 13		KEEP
6		Oct 12		End of Video Portapak Demonstrations (You Must have one to be able to use the equipment.)		UP
7	Oct 17				FIRST CONFERENCE ON PROJECT SELECTION NO LATER THAN 31 October [Based on short, written project plan]	THROUGHOU
8		Oct 19	Showing at 3:30pm in Harvard Hall			SEMESTER
9	Oct 24		Showing at 3:30pm in Harvard Hall			
10		Oct 26	Brief (1 typewritten page) critique of Goldmark due (one copy to section man, you hold one)			
11	Oct 31					
12		Nov 2			Written project plan approved at conference no later than November 14	
13	Nov 7					
14		Nov 9				
15	Nov 14					
16		Nov 16	Showing in Harvard Hall at 3:30 pm			
17	Nov 21		Showing in Harvard Hall at 3:30 pm			
18	Nov 28		Brief Critique Due Emphasize reasons for similarities or differences with first critique (1 copy to section man you hold one)			
19		Nov 30			Draft or Equivalent no later than December 12	Final D Date:
20	Dec 5					
21		Dec 7				Diary w Cours Evaluati
22	Dec 12					
23		Dec 14		Dec. 19 5-Min video tape due	FINAL DUE DATE: Friday, JAN. 19, 1973	FRIDAY
24	Dec 19					January 1

Natural Sciences 130

Fall 1972

Introduction

The staff of Nat Sci 130 hopes:

1. To create an atmosphere in which information, resources and assistance are abundant and in which you have the liberty (and the responsibility) to choose for yourself what you need and how you will get it.
2. To introduce you to complements or alternatives to the written term-paper; i.e., we recognize non-print media, as well as print, as valid forms of expression.
3. To encourage a relationship among staff and students which recognizes that everyone has something to teach and something to learn.

We particularly hope that you will supply free-form comments, criticisms and suggestions as they occur to you. There is a mail slot for these in Cruft 112, and we hope that you will use it. We assure you that none of your ideas will be swept under the rug, and we will gladly duplicate them for distribution to the entire class, if you wish.

Course Requirements

We believe that Nat Sci 130 is a small enough society to be able to work by discussion and understanding, rather than fiat. If you are unsure about what you should be doing, or whether what you're doing is worthwhile, don't fret in silence - come talk to one of us instead.

We see your work in the course as being organized along the following lines:

1. Term project
2. Diary
3. Five minute videotape (or alternatively, sound-slide or audiotape)
4. Mid-term exercise dealing with telecommunications and public policy
5. Course evaluation

The Project

One good way (not the *only* way, obviously) to begin thinking about the term project is to take a look at what the last two years' classes have produced. There's a partial list of these posted on the bulletin board at Cruft 112. Many of the projects were papers or reports on fieldwork, varying in length from a few to tens of pages. We aim at high standards of scholarship and craftsmanship, but we welcome diversity in length and subject matter in getting there. In fact, we encourage you to find alternative media suitable to the presentation of your project -- many of the finest projects were done in videotape in the past. Mainly, we hope that you will feel free to choose a topic and method of presenting it that fits your style.

Diary

We have received the same diversity in diaries as in projects. We do not wish to prescribe what is required, because a diary is (and must be, if it is to be valid) a personal document. On the other hand, the diaries are to assist you and us in the evaluation of the course. We would therefore like the diaries to give a record of your progress in Nat Sci 130; things which excite you, which bore you; which aspects of the course you think are succeeding, which you think are failing. In accordance with the intended use of the diaries, may we suggest that the following be included in your diary entries?

reactions to lectures and lecturers

opinions on the way instructional media are used (computers, videotape, slides, the classroom set-up, the lecture format).

progress of *your* work (notes on student-staff conferences, sections, discussions with others in and out of the course.)

Five-Minute Videotape

One of the goals of Nat Sci 130 is to acquaint you with electrical and mechanical communications devices, without overwhelming you with their complexity. The staff believes that hands-on experience is helpful toward this end. We would like each one of you to become acquainted with a communications device: its operations, its capabilities, its limitations. We've chosen videotape as the principal device for several reasons:

- videotape involves the use of both audio and video channels
- videotape is easy
- videotape is fun
- videotape builds strong bodies 12 ways

Once again, the nature of the product is left entirely to you. All we want is some indication that you have become familiar with the techniques of making a videotape. If you have a strong ideological aversion to videotape, or if you exhibit an allergic reaction, you may choose to make your presentation in a different medium, such as sound-slide or audiotape.

Course Evaluation

A brief evaluation of the course, and of your learning in the course, is expected of each student. We think that this will help both you and us to evaluate the term's work. This should be the final entry in your diary.

Readings

We will try to explain, as fully as possible, what the planned use of a particular reading is. If the readings are to cover a lecturer's topic more fully or from a different angle, but are not prerequisite to understanding the lecture, we will say so. If you will most likely be hopelessly lost or wasting your time if you come to class without having done the reading, we'll say that, too. The whole idea is to help you budget your time efficiently -- so that you can select the readings you do with consideration of what you want to get out of the course.

A menu of books for background reading will be issued shortly. The following three titles have been given to the Coop as required:

Brown, Les, Televi$ion: The Business Behind the Box, Harcourt Brace, New York, 1971

Davidovits, Paul, Communication, Holt, Rinehart and Winston, New York, 1972

Oettinger, Anthony G., Run, Computer, Run: The Mythology of Educational Innovation, Cambridge, Mass., Harvard Univ. Press, 1969.

The Brown and Oettinger books will be useful as background for the public policy segments of the course. The Davidovits book is a combination of general background and technical overview. It is well worth browsing through and using as a reference. Skip over any parts that are too technical for you.

Some materials, like the September 1972 issue of *Scientific American* will be distributed in class. *To cover the cost of these materials a charge of less than $10.00 will be levied on every student before the end of the semester.*

Sections

There will be no formal section meetings. However, a staff member who is not the lecturer will be in Harvard 104 before each lecture for informal discussions and reviews. The lecturer(s) will usually be available in Harvard 104 after class for discussions, fielding questions not answered in class, etc. We are also happy to help with any informal student discussion groups through announcements, our presence (or absence), etc.

Student-Staff Pairing

You will soon be randomly assigned to a staff member who will be your advisor. He or she will confer with you regularly throughout the term, and be primarily responsible for observing, assisting, and evaluating your work for the course. You are encouraged to seek the assistance of any staff member, however.

Evaluation Procedure

We hope that the collective energies of the course will be directed toward learning and interactions with other course members. We would like to minimize the energy directed toward grades. For this reason, we strongly urge you to take Nat Sci 130 on a pass-fail basis. (There are some catches, however. See handout re: Pass-Fail.) We have designed an evaluation procedure which emphasizes learnin As with every other aspect of the course, there is nothing sacred about our scheme. Your comments are more than welcome; they are essential for the future development of a process which is truly successful for both students and staff.

The evaluation procedure rests on the following philosophical assumptions:

1. The relationship between you and your staff advisor should be a partnership in which comments and criticisms travel in both directions and are not handed down from on high by the staff member.
2. Judgment by a staff member should be understood to represent the opinion of just one person. One way to gain this perspective is for you to seek the opinions of other staff members and of your peers.

3. It is just as important for you to judge your own work as it is for you to receive another opinion.
4. The staff won't force you to do anything. However, the less you work, participate, and avail yourself of the staff's services, the less you can expect the sympathy, respect and enthusiasm of the staff.

We encourage you to schedule a minimum series of individual student-staff conferences according to the schedule which follows. We hope that you will also schedule additional conferences with any staff member at any time.

First conference:	should be scheduled for mid-October, about the third week of the course, when you and your staff advisor will together map out the project, videotape, and diary, and discuss available resources.
Second conference:	Midway through the project to discuss progress, re-adjust goals, and attempt to cope with any problems that have come up.
Third conference:	Scheduled shortly after the project due date, in late December. Were project goals attained, surpassed, or missed? Why or why not? What are the possibilities and avenues for further work if you are interested? Was the chosen presentation medium the best. Should you make a class presentation?
Final conference:	Here the whole course will be discussed, your criticisms solicited, and your overall work also discussed.

Grading is done in a joint staff session to insure uniform grading criteria.

HARVARD UNIVERSITY

Natural Sciences 130

Fall 1972

cf: PASS/FAIL STATUS

We encourage pass/fail enrollment, but the game must be played as follows:

1. Students may elect to take Nat Sci 130 on a pass/fail basis or on a graded basis.

2. Any student who wishes to count Nat Sci 130 toward his basic requirement in General Education must take the course for a letter grade. Courses taken on a pass/fail basis do not fulfill the basic requirement in General Education.

3. A student who elects to take Nat Sci 130 on a pass/fail basis must list it as such on his study card. If not so listed, the student will be taking it for a letter grade.

Natural Sciences 130

1972 - 1973

COMMUNICATION IN SOCIETIES

A Menu of Books for Background Reading

* Indicates books on reserve in Gordon McKay, Hilles and Lamont Libraries.

Aaronson and Osmond (eds.) Psychedelics: The Uses and Implications of Hallucinogenic Drugs.

Allison, Graham T., Essence of Decision: Explaining The Cuban Missile Crisis, Little, Brown and Co., Boston, 1971.

Alsop, Stewart, The Center, Popular Library, New York, 1968 (Harper & Row paperback).

Altick, R. A., The English Common Reader, Chicago, University of Chicago Press, 1957.

*Altman, Stuart (ed) Social Communication Among Primates.

Atkinson, R. C. and H. A. Wilson (eds.), Computer-Assisted Instruction: A Book of Readings, New York, Academic Press, 1969.

Baer, Robert M., The Digital Villain: Notes on the Numerology, Parapsychology and Metaphysics of the Computer, Addison-Wesley, Reading, Mass. 1972.

Bagdikian, B. H., The Information Machines: Their Impact on Men and the Media, New York, Harper and Row, 1971.

Barrouw, Erik, A History of Broadcasting in the United States:
Vol. 1, A Tower in Babel, (to 1933) 1966.
Vol. 2, The Golden Web, (1933-1953) 1968.
Vol. 3, The Image Empire, (from 1953) 1970.
New York, Oxford.

Bartee, Fundamentals of Digital Computers, McGraw-Hill, 1971 or 2.

Barzun, Jacques, Science: The Glorious Entertainment.

Blum, Ronald (ed.), Computers in Undergraduate Science Education, College Park, Maryland, Commission on College Physics, 1971.

Bobinski, G. S., Carnegie Libraries: Their History and Impact on American Public Library Development, Chicago, American Library Association, 1969.

Bode, Hendrik W., Synergy: Technical Integration and Technical Innovation in the Bell System, Bell Laboratories, Murray Hill, New Jersey, 1971.

Boleslavsky, Richard, Acting: The First Six Lessons.

* Borchardt, Kurt, Structure and Performance of the U.S. Communications Industry. Boston, Mass., Division of Research, Harvard Business School, 1970.

Bowen, W. G., The Economics of the Major Private Universities, Berkeley, Calif., Carnegie Commission on Higher Education, 1968.

Bretz, R., A Taxonomy of Communication Media, Educational Technology Publications, Englewood Cliffs, New Jersey, 1971.

Brown, Les, Televi$ion: The Business Behind the Box, Harcourt Brace, New York, 1971.

Bruner, Jerome, S., Toward A Theory of Instruction, Cambridge, Mass., Harvard University Press, 1966.

Brzezinski, Zbigniew, Between Two Ages - America's Role in the Technetronic Era, Viking Press, New York, 1970.

Bucher, Lloyd M. (Cmdr.), with Rascovich, Mark, Bucher: My Story, Doubleday, New York, 1970.

Burling, Robbins, Man's Many Voices, Holt, Rinehart, New York, 1970.

Callahan, R. E., Education and the Cult of Efficiency: A Study of the Social Forces that have shaped the Administration of the Public Schools, University of Chicago Press, paperback, p. 149.

Capranica, Robert R., The Evoked Vocal Response of the Bullfrog.

Carnegie Commission on Higher Education, The Fourth Revolution: Instructional Technology in Higher Education, McGraw Hill, New York, 1972.

Carpenter, C. R. and Greenhill, L. P., Instructional Television Research, University Park, Pa., Pennsylvania State University, 1958.

Carroll, John B., The Study of Language, Harvard Press, 1953

Chartrand, R. L., Janda, K., Hugo, M. (eds.) Information Support Program Budgeting and the Congress.

Checkov, Michael, To The Actor: On the Technique of Acting.

* Cherry, Colin, On Human Communication, Wiley, New York, 1957.

Cohen, Sidney, The Beyond Within.

* Commission on Instructional Technology, To Improve Learning, Vol. I, (parts I and II)

* " " " To Improve Learning, Vol. II (p. III and VI)
New York, P. R. Bowker Company, 1970.

Committee on Telecommunications, National Academy of Engineering, Communications Technology for Urban Improvement, Report to the Department of Housing and Urban Development, Washington, D. C., June 1971.

Coombs, Philip, The World Educational Crisis, 1968.

Coulson (ed.) Programmed Learning and Computer-Based Instruction.

*Davidovits, Paul, Communication, Holt, Rinehart and Winston, New York, 1972.

Downs, Anthony, Inside Bureaucracy, Little, Brown, Boston, 1967.

Dreyfus, Hubert L., What Computers Can't Do: A Critique of Artificial Reason, Harper and Row, New York, 1972.

Enthoven, Alain C., and Smith, K. Wayne, How Much is Enough? Shaping the Defense Program 1961-1969, Harper and Row, New York, 1971.

Escarpit, R., The Book Revolution, Unesco Publications Center, New York, 1966.

Feigenbaum, E. A., and Feldman, J. (eds.) Computers and Thought, McGraw-Hill, New York, 1963.

Fenichel, Robert R. and Joseph Weizenbaum, Computers and Computation - Readings from "Scientific American", W. H. Freeman and Company, San Francisco, 1971.

Fetter, William A., Computer Graphics in Communication, McGraw-Hill, 1965.

The Focal Encyclopedia of Film & Television Techniques, Hastings House. 1969.

Gibson, J. J., Perception of the Visual World.

Gilchrist, Bruce and Milton Wessel, Government Regulation of the Computer Industry, AFIPS Press, Montvale, New Jersey, 1972.

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Agranoff, B.	Memory and Protein Synthesis
Andrew, R.	Origins of Facial Expression
Asch, S.	Opinions and Social Pressure
Attneave, F.	Multistability in Perception
Bales, R.F.	How People Interact in Conferences
Barron, F. et al	Hallucinogenic Drugs
Bennet-Clark, H.C. and Ewing, A.W.	The Love Song of the Fruit Fly
Beranek, L.	Noise
Berlyne, D.E.	Conflict and Arousal
Bobeck, A.H. and Scovil, H.E.D.	Magnetic Bubbles
Bonner, J.T.	Hormones in Social Amobae and Mammals
Bonner, J.T.	How Slime molds Communicate
Bower, T.G.R.	The Visual World of Infants
Broadbent, D.	Attention and Perception of Speech
Bullard, D. E.	The Detection of Underground Explosions
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Pribram, K.H.	Neurophysiology of Remembering
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Smith, N.G.	Visual Isolation in Gulls
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Tribus, M. and McIrvine, E.C.	Lightness and Retinex Theory
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Washburn, S.L.	The Social Life of Baboons
Watts, C.R. and Stokes, A.W.	The Social Order of Turkeys
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Wenner, A.M.	Sound Communication in Honeybees
Wilson, E.O.	Pheromones
Winkler, E.C.	Lighting for Color Television
Wynne Edwards, V.C.	Population Control in Animals
Yngve, V.	Computer Programs for Translation
-----	Zoom Lenses: A Close-up View

Videotapes of the Telecommunications Conference

Summer 1972

LES BROWN television and radio editor of Variety, draws from twenty years of experience as a journalist, entrepreneur and teacher in the entertainment field. A former song writer, television script writer and producer, he attracted Joan Baez, Bill Cosby, Bob Dyaln and others to perform early in their careers at his avant garde Chicago cabaret, The Gate of Horn. His book, Televi$ion: The Business Behind the Box, was published by Harcourt Brace Jovanovich in the fall of 1971.

GEORGE DUFFY is President of Colonial Cablevision Corporation, a local Boston cable television company that has operating facilities in Woburn and Revere.

PETER GOLDMARK is President and Director of Research of Goldmark Communications Corporation. He retired last year as President and Director of Research of CBS Laboratories, having joined CBS in 1936 as Chief Television Engineer. The LP 33-1/3 rpm record and Electronic Video Recording are among his best known inventions. As chairman of a National Academy of Engineering-Connecticut Research Commission joint committee on urban problems, he has sparked the concept of using telecommunications to link newly-created "satellite cities" with metropolitan urban centers.

RICHARD HOOPER, an Oxford graduate who has worked on both the radio and TV sides of the BBC, is Senior BBC TV Producer in the Open University's Faculty of Educational Studies. As a Harkness fellow in 1967-68, he traveled extensively in the United States surveying developments in educational technology. He served as Special Staff Consultant to the U.S. Commission on Instructional Technology, has published articles on education and educational technology on both sides of the Atlantic and just edited a book on curriculum development.

PAUL KLEIN is President of Computer Television Inc., New York, and hopes to wed the computer to cable television on a pay-as-you-view basis. From 1961-1970, he worked for NBC as supervisor of ratings, manager of audience measurements, director of audience measurements and VP, audience measurements. He is also a consultant to both the Public Broadcasting Service and the Ford Foundation.

TED LEDBETTER is Engineer and President of Urban Communications Group, CATV Management and Engineering Consultants in Washington D.C.

MARTIN UMANSKY is General Manager of KAKE TV, an ABC affilate, in Wichita, Kansas.

NATURAL SCIENCES 130

Once you have had a demonstration on a piece of equipment, you may check it out or use it in the studio, depending on its restrictions, i.e., 1" tape recorders are not checked out.

Each Monday, at 9:00, a sign-out list applying only to that week will be posted on the door of Cruft 111. In general you may not reserve equipment for more than four days in advance. If you have set up an interview or want to tape a fleeting or infrequent event (like the eclipse), see Carol to reserve the equipment for that date.

For the portapaks, two will be available to Nat Sci 130 students. There is a third one that you can use only if no one else from outside the course shows up at the check-out time. You can only sign up for the portapak for one period in advance each week. If you work with a partner, then it is two periods, etc. However, if no one else wants to use it, you may check it out again that same week.

The equipment may be retained for the length of a "period". These periods will be subject to change depending on demand. (During the end of the semester they will be shortened.)

The present periods are as follows:

9:30 AM - 4:00 PM
4:15 PM - 9:15 AM the next day

Equipment checked out Friday afternoon
is due Monday morning.

EQUIPMENT MUST BE BROUGHT BACK ON TIME.
When you return it you must wait until it is checked out, otherwise you may be held responsible for damage you did not do.

Those who sign out a portapak with batteries and/or the battery belt for overnight are responsible for charging the batteries so that the next day's users will be able to shoot without the power adaptor.

Make sure that you have all the equipment you need. Remind the check out person to make sure that your tape heads are clean.

CAVEAT!!

The videotape equipment is extremely expensive. Although it is insured, the policy is $100 deductible: if you lose or damage any equipment, or if it is stolen while it is signed out to you, you will be held responsible for an appropriate amount up to $100. (The current price of a vidicon tube is around $60.)

Cambridge is not a safe place in which to have expensive equipment. In the past, there have been a number of thefts of audio-visual equipment checked out to students. Therefore, it is advisable not to leave anything unattended. If you have to leave equipment in your room or car, make sure it is out of sight and securely locked.

Floyd the Fence

Giving a'feel' for what "Bandwidth" means operationally - or an introduction to Hi-Fi and the terms of music synthesis. (selections from Nonesuch Guide to Elect. Music)

If some things aren't clear - ask questions, but some of the details will be left for a course in physics.

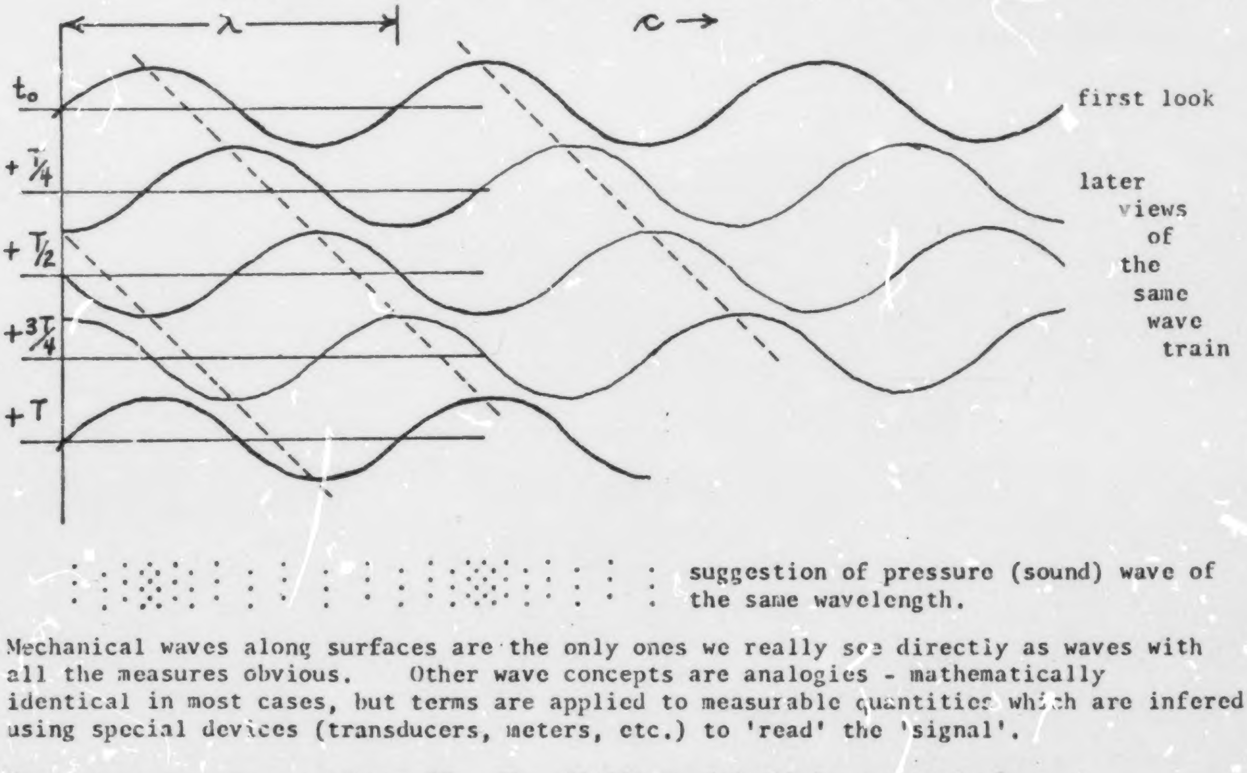
Disturbance - propagates as the result of restoring forces - transient wave
Periodic disturbance - continuing propagation which repeats amplitudes in fixed time
 - gives wave trains
Water Wave - wavelength - period - frequency - phase

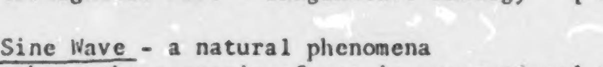
- λ - wavelength, length between nearest corresponding points of wave (cm)
- T - period, time for one wavelength to pass a fixed point (sec)
- f - frequency, number of periods in a unit of time (Hz) (cycles per second)
- c - velocity of wave

$$c = \lambda/T \text{ or } \lambda f \quad (\text{cm/sec})$$

for light in vacuum $c = 3 \times 10^{10}$ cm/sec
for room temp. air $c = 1130$ ft/sec

ϕ - phase, relationship of two waves of same frequency but having maxima at different times - $\phi = +90°$ if wave leads by T/4 sec the reference wave



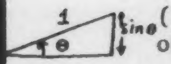


suggestion of pressure (sound) wave of the same wavelength.

Mechanical waves along surfaces are the only ones we really see directly as waves with all the measures obvious. Other wave concepts are analogies - mathematically identical in most cases, but terms are applied to measurable quantities which are infered using special devices (transducers, meters, etc.) to 'read' the 'signal'.

Sound wave - a close anology [f = 20 - 20,000 Hz (pitch) human hearing]
Electromagnetic wave - imaginative analogy [radio, TV, IR, Light, UV, Xrays]

The Sine Wave - a natural phenomena
 where the restoring force is proportional to displacement and related to behavior in many natural force fields.
It is the accomodation of this apparently basic relationship that brings to applied math all sorts of 'simple' expressions using sine, cosine, etc.

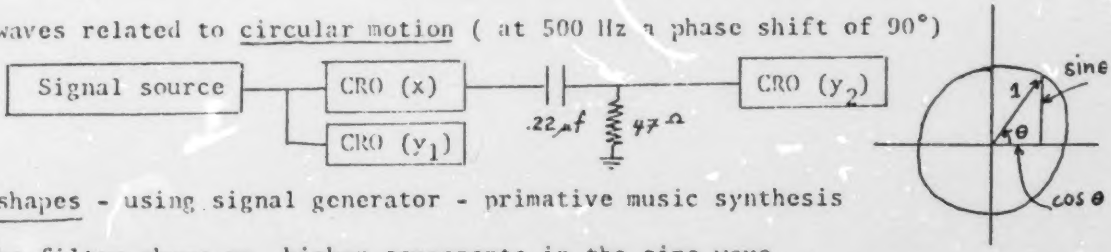


(in geometry the sine of an angle is the ratio of the opposite side to the hypotenuse of a right triangle)

Spring - pendulum - string - water wave(deep) - heat flow - electrical currents ...

Demo: Spring and CRO (Cathode Ray Oscillograph or Scope)
use of beam of electrons to 'write' on phosphor surface (as in TV)
may be driven by external signal or internal clock (oscillator)
Measured voltage can correspond to - wave height for water
pressure of sound wave (intensity)
voltage(or current) of electrical signal
Pressure waves in air made by moving surfaces (speaker cones, bells, etc.)
Detected by moving surfaces (microphones, ears, etc.)
Demo: Motion of speaker cone produces pressure waves in air - these in the proper frequency range may be perceived as sound.

Demo: Sine waves related to circular motion (at 500 Hz a phase shift of 90°)



Demo: Wave shapes - using signal generator - primative music synthesis

using the filter shows no higher components in the sine wave
higher components are present in most other wave shapes (filter has time response)

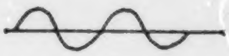
Demo: line with capacitor to ground attenuates high frequencies
Linear - wave components simply add
Non-Linear - no simple expression for combinations or resolving components

Demo: filter settings define a bandwidth - the min and max f sine waves that pass

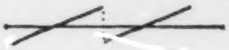
Demo: Speach - first at full frequency range -
using active filter - select middle 200-2000 Hz
show below 200 Hz and above 2000 Hz

Demo: music synthesis using Nonesuch sample

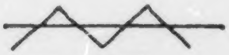
Fourier Series



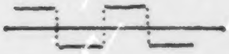
f(x) = sin x



f(x) = 2(sin x - 1/2 sin 2x + 1/3 sin 3x - 1/4 sin 4x +...)



f(x) = 4/II (sin x + 1/9 sin 3x + 1/25 sin 5x +...)



f(x) = 4/II (sin x + 1/3 sin 3x + 1/5 sin 5x + ...)

1972/10/5 R. Land

NATURAL SCIENCES 130

II-26

Non-verbal communication I — Demonstrations

Caveat: This is an exposure - neither exhaustive or free of subjective speculation.
an overload of information - try for a feeling or impression, take what you want.

Slides of lumia/ Computer music - Illiac Suite(1957)
Talk about Non-verbal communication? - 'least' ambiguous way.
Where do you look? --- WHY DO YOU LOOK? Signal/Sign/Symbol
Natural response to clues -- you supply the meaning
Meaning distinguished from Information (what we make of it vs raw data)

Attention - Agreement - Context - Frame
"Communication is possible only through a degree of novelty in a context that is familiar." "A common Language is of extreme advantage ... but it is not as important as a common interest and some degree of common understanding." .R.Pierc

SLIDES
other n-v: Music and the other arts inc. poetry of many sorts.
Sports, games, sexual transactions
Socializing cues (dress, grooming, life style, habits...)
Driving, waiting, casual watching, crowd membership, party-manship
Costume and makeup - amplifiers of our character to rise above noise levels.

PREVIEW:

10/17	Sine waves, Sound, Electrical Communications, Synthesizers Audio-visual demonstrations	Pierce 110
10/26	Music more generally w/ Paul Berman	Sanders Theatre
10/31	Non-Verbal II - visual arts more generally to computer arts and demonstration of kinetic art (ESP/Occult Sci/Drugs mentioned if inter.	
12/7	Technology of the theatre - demo. Kelly Yeaton, guest, disc. of process of rehearsal and exp. theatre	Loeb Drama Center
12/19	Language and Linguistics - Prof. Oettinger	

In approaching any consideration of the mind one must clearly distinguish our expression of an idea from its representation in the mind. What a thought looks like on paper, or sounds like in a lecture, is properly adapted in some evolved fashion to the capabilities of our muscles and senses, not a presentation of the neurological functions which produced it.

My thought ---- translated ---- my words expression/evocative
Your hearing ---- translated ---- your thought (S&W diagram)

KNOWING? "The object known and the knowing object" Wm. Hamilton
imagine objectivity, experience subjectively atomistic/gestalt (S)
Channels --- bandwidth related to 'bits' per unit time --- flow of information
Senses ---- see chart ***** quick survey
Illusions Mistakes vs persistant illusions vs inovative perceptions?
Touch/Taste/Smell --- tape of audio ill.
[Digression to mention wave propagation and the nature of sound and light]
Sight considered in some detail - light levels (S) note:TV tape on lenses
scanning eye - but the world stands still - small field - samples
system gives stability to dynamic world and various inputs tube/flashligh
character of retina
Mach Bands - edge detection - Xerox like (S) & disks & card
System response Webber - Fechner - Stevens $dI/I = K$ is it exp or log for S?
Subjective Colors - disks demo of time dependence
Depth cues (S) motion, binocular, and monocular somewhat ranked usually related

"The human eyes voluntarily and involuntarily fixate on those elements of an object which carry essential and useful information. The more information is contained in an element, the longer the eyes stay on it. The distribution of points of fixation on the object changes depending on the purpose of the observer, i.e., depending on the information which he must obtain, for different information can usually be obtained from different parts of an object... Hence people who think differently also, to some extent, see differently. [Yarbus, Eye Movements and Vision]

10/29/71 R. Land

MATURE HUMAN SENSES (Suggested by: R. W. Moncrieff - The Chemical Senses
(Bandwidths are my estimates - reaction times during which sensations persist from: Allen & Weinberg, Quart. Jour. Exper. Physiol, 15, 396, 1925)

Sense	Physical Nature	Local-ization	Reaction Times (sec)	Bandwidth (Hz)
Sight - eyes (400 - 800 nm)	L/M*	ext	0.013 to 0.045	10^7
Hearing - ears (20 - 20,000 Hz)	Mech*	ext	0.0127 to 0.0215	10^5
Smell - nose	Chem	(ext)	(0.003)	10^4
Equilibrium - semi-circ. canals	Mech*	int	-	10^4
ouch - skin + other organs	Mech	surf	0.0024 to 0.0089	10^4
Pressure	*			
Temperature (hot/cold)	*			
Pain (shallow and deep)				
orce and Weight - muscle	Mech*	(int)	-	10^3
aste - tongue (mouth)	Chem	surf	0.0015 to 0.0040	10^2
bitter				
sweet				
sour				
salt				
rritation - mucus membranes	Chem*	(ext)	(0.003)	10^2
Hunger internal sense - unknown source				
hrist part of elaborate feedback system				
probably a combination		primative sense		10
ex of senses & hormone systems				

(*capable of transducer measurement)

ight adaptation range (Scale of luminance levels for typical stimuli)

	Luminance (millilamberts)	Iris Diameter (mm)	
	10^{10}		
un's surface at noon	10^9		damaging to retina
	10^8		
	10^7		
ungsten filament	10^6		
	10^5		
hite paper in bright light	10^4	2	Photopic
lear day	10^3	3	(color vision)
omfortable reading (5' from 100 watt l.)	10^2	4	
unset overcast day	10	5	
/4 hour after sunset)clear)	1		
/2 hour after sunset (clear)	10^{-1}	6	Mesopic
hite paper in moonlight	10^{-2}		
one threshold Moomless-clear night sky	10^{-3}		
hite paper in starlight	10^{-4}	7	Scotopic
	10^{-5}		(colorless vision)
bsolute rod threshold	10^{-6}		

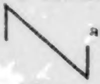
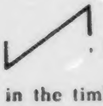
sharp edges at any point, and therefore represents a smooth increase and decrease in voltage over a period of time. It exhibits uniform repetition from wave to wave and sounds somewhat similar to the human vowel sound "oooooo".

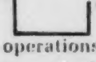
Previously, oscillators in electronic-music laboratories were almost exclusively sine-wave sources. Later, square-wave generators were added. In "classical" systems of recording electronic music, each sound was recorded separately, spliced or pieced together and re-recorded in combination- a long, tedious process. However, oscillators now available provide four basic waveforms: sine, sawtooth, triangular, and variable rectangular, making the desired basic timbres much more easily accessible. On many synthesizers that utilize *voltage-control* it is possible to control frequency automatically by means of external equipment connected to the oscillators (Chapter III) as well as manually by the old-fashioned *sweep-frequency* method. As a result, dynamic variations of frequency are now possible.

With a combination of sine waves in proper relationship to one another, both as to frequency and intensity, one can synthesize any audible sound. For example, if a number of sine-wave oscillators are tuned in harmonic relationship to one another as follows:

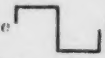
1st Oscillator, 1st harmonic, fundamental, or any frequency "f"
2nd Oscillator, 2nd harmonic, 2xf, one octave higher
3rd Oscillator, 3rd harmonic, 3xf, an octave and a perfect fifth above fundamental
4th Oscillator, 4th harmonic, 4xf, two octaves above fundamental
5th Oscillator, 5th harmonic, 5xf, two octaves and a pure major 3rd above fundamental
6th Oscillator, 6th harmonic, 6xf, two octaves and a perfect 5th above fundamental
7th Oscillator, 7th harmonic, 7xf, two octaves and a harmonic 7th above fundamental
8th Oscillator, 8th harmonic, 8xf, three octaves above fundamental

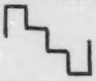
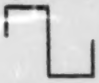
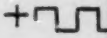
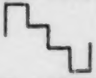
(the series may continue to the upper limits of audibility), the combination of these sine waves in various proportions creates a great number of tone colors or timbres. If enough oscillators are available, these timbres can imitate strings, brass, winds, and the vowel sounds of the human voice, all of which are harmonic in character.

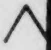
An infinite number of sine-waves oscillators combined in harmonic relationship *in phase* with one another, and in a gradually decreasing order of amplitude, result in a *sawtooth* or *ramp wave.* It exists in two forms: descending  and ascending , and is most frequently represented in our experience in the timbres of many historical and conventional instruments of our culture. Theoretically, it is made up of all harmonics, of odd- and even-numbered order, through infinity, and is the most useful generator a studio can possess. In a relatively natural state, the sawtooth wave sounds string- and brass-like. However, by filtering out the high frequencies of a sawtooth wave played in the middle registers, one can closely approximate a flute sound. Conversely, by filtering out the fundamental, one can produce an oboe-like timbre. However, the colors mentioned here by no means even approach the number of possibilities available using this waveform.

The *rectangular wave* or *pulse wave*  can be thought of as representing a series of switching operations where voltage of the waveform rises instantaneously to a maximum value, remains at that value for a given period of time, and returns just as abruptly to a minimum value, where it again remains for a given period of time, thereafter beginning a new cycle. Rectangular waves are harmonic, composed entirely of frequencies bearing a harmonic relationship to one another. The proportionate relationship of time between the two voltages, the *duty cycle*, has
a strong effect on the harmonic content. These different
cycle relationships allow operators of synthesizers having
able-width rectangular-wave oscillators to create a wide ran
new timbres that are harmonic, closely related to traditional m
yet sufficiently different to be extremely valuable to the
tronic-music composer.

L2

The *square wave*  is a special case of the rectan
wave that has a duty cycle of 50% (at one voltage half the
and another voltage half the time). It is made up only of
numbered harmonics. The rate of amplitude descent of its
monics is identical with that of the sawtooth wavefor
sound is that of a bright, strongly played clarinet, but of extr
hollow timbre.

The *staircase wave*  , widely available on ine
sive electronic organs, is produced by combining two or
square-wave generators in octaves.  + 
 Since there are more sharp corners on the
form, a sound buzzier and slightly more brilliant than a saw
results. The simple staircase wave is deficient in the harm
that are higher octaves of the fundamental, since it includes
the series: 1, 2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15, 17 . . .

A *triangular wave*, sometimes called a *delta wave*, 

V

sounds somewhat like a softly-played low-register clarine
contains only odd-numbered harmonics in a rapidly desce
order of amplitude. It, like the sine and square wave, c
either inverted or flipped end-for-end, or both, without any
metric change other than lateral displacement. Note that
ever this can be done with any waveform, it is devoid of
numbered harmonics.

W

Finally, we come to *white sound*, an extremely complex
produced by a special generator. It is analogous to white
in that it is made up of an infinite number of audible frequ
distributed over the entire spectrum. Each frequency appe
random, but over a period of time has equal power. As
case of a jet engine, escaping steam, or a crashing wave, a
quencies are, again, randomly present in varying amoun
synthesize these, one would ostensibly need an infinite n
of sine wave oscillators. Whenever white sound is filter
equalized, the result is termed *colored sound* just as the fil
of white light produces colored light. Many natural sound
tain a measure of sibilance, hiss, or buzz which can be ap
mated or duplicated by filtered white sound. The starting
sients (attacks) of most orchestral instruments have great am
of filtered white sound. In all percussive sounds of cymbals,
snares, castanets, and sand-paper, colored sound is an indi
eble component. When filtered extremely sharply, it will pr
a strong feeling of pitch.

Any audible sound transformed into an electrical signa
be used as a signal generator. Possibilities include am
acoustical instruments, voice, and natural sounds picked
a microphone or vibration-sensitive device, and previous
corded material of all types. These kinds of sounds, whe
in electronic music, are referred to as *external signal gene*
Tape-recorded natural sounds are the basic elements of "m
concrète".

NOTE: By controlling the audible frequency of one osc
with the output of another at a sub-audible frequency, o
actually "hear" the shape of the latter's waveforms. C
demonstration record this has been done with each of four
forms sine, sawtooth, rectangular, and triangular.

III. VOLTAGE CONTROL

Electronic-music techniques took a giant step forward
early 1960s with the widespread introduction of *voltage c*

NATURAL SCIENCES 130 II-29 1972/10/31 R. Land

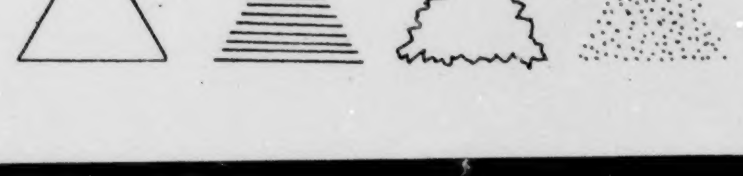
An Illustrated Commentary

Non-verbal Communication III
Caveat: as before - an exposure, engage it subjectively
Slides of Computer Art/ Electronic music (Oskar Sala, Five Improvisations-West-14143)

Where do you look?--- WHY DO YOU LOOK? Attention/Agreement/Context/Frame
Learning to use the senses - Wake to eat/then eat and "play"/then "play" and eat.
Constellation of clues - feature extraction i.e. costumes & makeup
"Demonstrations would seem to indicate that perception is indeed a synthetic activity, but one guided by clues extracted by the filter mechanisms:what we see has many elements which come from the structure within rather than from the stimulus without."(DMM)
→Consciousness - Attention - Perception(agreement) - Prehension(intuition)↩
Is a musical instrument more really its visual image, or its sound, or its discription in physics? In dealing with abstracted sense criteria, compromises in the information handling must be made. There just isn't time to use all the available data - BESIDES IT ISN"T STABLE! There is much that is non-verbal and indeed cannot at this time be made verbal, which offers a fronteer for communication study.
Sensitivity/Psychoactive Materials/Psi Phenomena/Occult 'sciences'
Technological influence on learning to use the eyes, learning to "read" what we see.
Cave Art Sculpture(shadows) Maps(memory,mnemonic techniques, problem solving)
Architecture & Stained Glass(public library of their time) [note EHG problem]
Theatre "...it does not seem that the word is the same tool for dramatists that it once was. Is it that we are living in an age of images?" (PB) [note thea. books]
Print ---The most sophisticated of our senses we use imappropriately when reading!
"People sometimes wonder why the Renaissance Italians with their intelligent curiosity, didn't make more of a contribution to the history of thought. The reason is that the most profound thought of the time was not expressed in words, but in visual imagery."(KC)
"For as we scan the flat pigments for answers about the motif "out there", the consistant reading suggests itself and illusion takes over... Long before experimental psychology was ever thought of, the artist had devised this experiment in reduction and found that the elements of the visual experience could be taken to pieces and put together again to the point of illusion."(EHG)
Photographs/Movies/TV/Disney World (seeing unseen or unseeable events?) (time & space)
"Facts that are symbols - and laws that are their meanings." (SKL)

Lumia - word offered by Thomas Wilfred, who started most successful work c. 1920
Kaleidoscope / Fantasia (1939) / Psychedelic
Hearing and vision not intrinsically related (no natural examples?) (synethesia?)
Non-Verbal conversation with Greg Levin
"The scientist strives to dispel illusions...The artist strives to create illusions."(AM)

A dot . lots of dots .... a line —— lots of lines △ = a picture
Computer Graphics - PDP-1 arrangement Dan Cohen's programs
(agraphical calculus and the use of instances - absolute and relative points)
Color - Computer Art(NEEDS A BETTER NAME?)
Theatre design, music composition, perceptual studies, 3-D, and space drawing
These consistant illusions perhaps point to sense clues which form a basis for a richer system of communication. Photographs, movies, TV, and art techniques are related or abstracted from nature using clues learned from natural processes. The computer can produce novel viewing tasks - unfamiliar representations. Training with such super-natural viewing may expand our sensory repertoire and develop new tallents in perception. This is the 'poets' problem, making ideas visable.
By seeing more perhaps we can learn to know more!



12
A 13C
14

R. Land 72/11/13

Notes for NS 130 People

You may ignore all if you like - but some should be of interest rather generally.

Houghton Library

I strongly recommend that everyone make at least one visit. Upstairs are permanent exhibits, Keats among others, open 10-12 AM, 1-4 PM. The main floor exhibition room to the left has changing displays. Try the card catalogue and request some item to read there in the reading room - it is well worth a few hours.

Books on list (or other) relating to Non-Verbal communication

Langer - Excellent philosophical treatment of metaphorical transformations - treats "facts that are symbols and laws that are their meanings." When the introduction slows you down, skip to language or music section. Diaries in the past have noted the value of this book.

Richards - Exciting book by a poet anxious to educate the world through coordinated use of eye and ear. Last essay is especially apt: "Learning and Looking."

Boleslavsky - Must reading for any actor, fast, short reading - long on doing!

Checkov - Many cues to non-verbal expression and good for self-projection as well. The exercises suggested throughout are much like the present 'T-group' work.

Brook, Peter, The Empty Space - A remarkable distillation of a man's theories and his works. Like all cases of asking an artist 'why?' we cannot expect this to be artless, or all fact and obvious simple explanation. The book reads a bit like a poem, having a definite thrust and great clarity of expression.

The Drama Review, T-53, March 1972 - discusses acting from many points of view. Of particular note is the "Delsarte: Three Frontiers," referring to techniques of gesture, kinesics, and semiology.

Chevereul Pendulum

Check the rack of notes in Cruft for the "Assignment for Nov. 1[illegible]th" (some other year). It explains how you can investigate a curious feedback phenomenon.

Dec. 7th Loeb

Kelly Yeaton will be guest. Has just recently written me - "What is really wrong with theatre exploration is much plainer to me now, anyway. It's the language of communica and the feedback loop. Our language should be performance images. Very expensive mechanism." He will be around several days to rap as we wish.

Disney World

Did you miss the NY Times article, "Mickey Mouse Teaches the Architects"? It seems to have the same shortsightedness exhibited by the Goldmark material. NYT, October 2 1972 Magazine section p. 40 ff. (Also note Direct Mail article, too.)

Technocrats

The ability to predict and perhaps change events has always given a significant place in societies to the sciences. The Pharaohs had their priests to tell when the Nile was about to flood, a vital piece of information; thus solar time was well known before 4,000 BC. In tribal societies there is generally a 'medicine man' who knows what 'science' is available; his talents support the chief. Leaders have always had their technologists to support their authority; Leonardo was of service to many artistically as well as in the design of weapons and defenses.

Card Communicator (I have it in class each day.)

This is a way of communicating with me - or me with you - by notes. This file device has has flip-up sections; all my advisees have name cards; others may put themselves in if they like. Yellow cards are my notes as addressed. White cards are for me.

Anechoic Chamber visit

For those who really would like to 'hear' silence, I think I can arrange for visiting a room at MIT especially designed so that after sitting very still one may hear one's heartbeat, and perhaps even molecular motion against the ear drum. If you are interested, put your name on the communicator card marked "Anechoic." The visit would probably be some Tuesday after class. Only 10 at a time can take about 30 minutes for the full effect; then another group could try.- max probably would be four groups of ten.

If you have not had enough - I'll be giving a lecture and demonstration at the Carpenter Center January 11th and will be doing some color demonstrations; will try to use TV to show computer graphics in real time, and will also have some Lumia instruments. The title - Technological Influence in Visual Expression (little duplication with class demonstrations but clearly related).

VIDEO SHOW --- Tapes from round about.

TIME: 8:00-11:00, P.M. Friday, November 17, 1972.

PLACE: Aiken Computation Lab Conference Room (Harvard, across
from Peabody Museum)

OPEN TO THE PUBLIC, an extra added attraction for Nat. Sci. 130.

Electronic visions are spawning round the country and over the world. New technologies enable us to retool conventional (dare I say filmic) visions (see below: Beer and Rudi Perez' Dance by Fred Barzyk) but in some cases, the tech has itself become its own frontier for discovery. (see below: synthesizer tapes, Keyedback Bach & Three-D Feed, The Metaphysical Circuit). Cheap and portable equipment opens the door for television as a folk-art (see below: public access video, children's tape) or a personal diary of perception (see below: 7 Women #1). This is far from an exhaustive show but it outlines some current directions in video work.

BILL OF FARE

TAPES BY FRED BARZYK AND OLIVIA TAPPAN (WGBH, PBS)

Beer: with Gene Shepherd, an exerpt from *Gene Shepherd's America* (PBS) shot in Fred's home town of Milwaukee on the CBS/Norelco PCP/90, the first hand-held broadcast quality color camera. The technique is derivative of film (one camera, post-edited, voice over *cum* cutaways) but the textures, light and tones are idiomatically video.

Rudi Perez' Dance, choreography on location at the new City Hall again using the PCP/90. But this show was conceived and worked out on portapak before final shooting with the heavy tech. Its editing is sophisticated (dissolves, supers, separate sync-sound mix) but its basic content is obtainable with portapak and 3650.

SIMPLE VIDEO-TRONIX

Feedback, untitled, by Mark Allan. Good mandala feedback done by a Harvard senior with patience and a playful eye. Improvised live with live musician, so we would call it 'real-time composition.'

Keyedback Bach, by Vince Canzoneri. Feeding back the inputs of two cameras thru an SEG and a keyer, which switches between inputs (overlaid) according to the grey scale of one or the other. Music overlaid.

3-D Feed, by Vince Canzoneri. Simple triangular feedback re-fed thru a triple bank of monitors, an SEG and a keyer.

Film, untitled, by Mark Allan. Using real-image and feedback video, shot off the monitor to 16mm film, colorized on an animation overlaid and intercut with film images, with the soundtrack i vised in real time to the completed work print.

COMPLEX VIDEO-TRONIX

Tapes, by Ron Hays of the Music Image Workshop (Paik-Abe Synthesizer) at WGBH.

Tapes, by Stephen Beck, Videographer and Designer at the National Center for Experiments in Television at KQED in San Francisco. Improvised images (a work in progress) from entirely electronic sources. (pending final release from Beck)

LIVE VIDEO-TRONIX

The Metaphysical Circuit from the recent Dallas Electronic Concert and the Dallas Center for Experiments in Television. Live dancers and live video cameras, feeding images through the Beck synthesizer and the Dowe colorizer to a projection screen on-stage with the dancers. A b/w portapak documentation of the piece.

PUBLIC ACCESS VIDEO

A proposal for meaningful public access production, prepared on tape for the recent hearings of the Governor's Commission on Cable Television in Massachussetts, by Vince Canzoneri and Wilson Chao.

Tapes from Open Channel, foundation-sponsored production company (½" b/w) helping local groups to use the public access channels in NYC. Wilson Chao, Technical Director.

FOLK-ART VIDEO

Children's Tape, untitled, by Wilson Chao. Two hours' work with two kids at a summer camp, in-camera edits and sound-track from the kids' own cassette library.

7 Women #1, by Vince Canzoneri. One-camera exploration of elements in interpersonal visuality and visual communication between two people of the opposite sex. (pending completion)

Some interesting reading:

? Rudi Armheim, Film as Art, the little chapter toward the end on tv.

Performance #3, the Publick Theater's quarterly (?), this issue being a symposium on television.

R Int. [illegible] Radical Software, the most recent issue being perhaps the best.

Expanded Cinema, by whatsisname, there's a section on video.

```
LOOP ←EXPR(;NONE)
   BEGIN
        LOOP:  PRINT("THIS IS NAT SCI 130, HOW DELIGHTFUL
");
                 GOTO LOOP
   END;
```

I

```
COUNT ←EXPR(;NONE)
   BEGIN
        DECL I:INT;
    LOOP:I←I+1;
        PRINT(I);
        PRINT("
");
        GOTO LOOP
   END;
```

II

```
COUNT\BREAK ←EXPR(K:INT;NONE)
   BEGIN
        DECL I:INT;
    LOOP:I←I+1;
        I=K =>PRINT("DONE");
        PRINT(I);
        PRINT("
");
        GOTO LOOP
   END;
```

III

```
FOR\LOOP←EXPR(;NONE)
   BEGIN
        FOR I FROM 1 BY 15 TO 226 DO
                 BEGIN
                      PRINT(I);
                      PRINT("
")
                 END
   END;
```

IV

```
MAKEGRAPH←EXPR(VERTICAL:INT,HORIZONTAL:INT;NONE)
   BEGIN
        DECL TOP\LIMIT:INT BYVAL 10*VERTICAL;
        FOR I FROM 0 BY 1 TO 9 DO
           BEGIN
                 MEASUREPRINT(TOP\LIMIT-(I*VERTICAL));
                 IN\BETWEEN\PRINT()
           END;
        PRINT(" 0---------!---------!---------!---------!---------!---------!
");
        BOTTOM\LINE\IT()
   END;

MEASUREPRINT←EXPR(VALUE:INT;NONE)
   BEGIN
        PRINT(VALUE);
        PRINT(" ");
        PRINT("+");
        FOR K FROM 1 BY 1 TO 5 DO
           BEGIN
```

VI

```
                PRINT(            . * )
           END ;
        PRINT("
")
   END ;
```

```
IN\BETWEEN\PRINT←EXPR(;NONE)
   BEGIN
        FOR L FROM 1 BY 1 TO 10 DO
            BEGIN
                PRINT(" †
")
           END
   END ;
```

VII

```
BOTTOM\LINE\IT←EXPR(;NONE)
   BEGIN
        PRINT(" 0");
        FOR H FROM 1 BY 1 TO 5 DO
           BEGIN
                PRINT("          ");
                PRINT(H*HORIZONTAL)
           END ;
        PRINT("
")
   END ;
```

V

```
SMASH\IT\BREAK\IT ←EXPR(Q:REAL ;REAL)
   BEGIN
        Q←Q*Q*Q*5.0;
        Q←Q/123.89;
        Q←Q+3.45;
        Q←Q*Q;
        Q
   END ;

.
```

IX

APPENDIX III

AN EMPIRICAL ANALYSIS
OF
NATURAL SCIENCES 130
I

Fall, 1970

Nikki Zapol

Most college courses demand that the student produce some form of written material, be it reports, laboratory data, essays, stories, whatever. This material is usually graded and returned to the student, but is rarely analysed for any more information about the student than what his grade should be. What did he get out of the course? What, indeed, did he do in the course? What does the grade represent -- involvement, interest, agreement (sincere or feigned?) with the professor; one week's work over spring vacation, or a life-time of concern? What aspects of the course did he like most (a question of content as well as teaching styles)? Did his failure to get involved have any connection with what was happening in the course? What? And to all these questions, the inevitable Why?

Such questions as these have importance to anyone concerned with education. If we don't know what is happening to the student -- what he is doing, and why -- we cannot hope to design optimal conditions for his personal and intellectual growth. It is undoubtedly true that the written material from most courses, even if thoroughly analyzed, would not yield the kind of information described above. By reading a history paper, a professor can only estimate whether the student has come to understand the basic methods of historians, whether he has a feel for the way in which historical facts should be handled, and whether, finally, he has actually "covered" the material which the professor feels is important. The professor knows nothing about how or why the student has actually accomplished the task; whether the student already knew what to do; whether the professor actually "taught" the student something, or whether the student's roommate was really responsible for his success -- or failure. Indeed, the professor may not even know whether the student did the paper himself at all. Of course, most professors circumvent this problem by using the traditional examination to determine whether the student has gotten the information, principles, or techniques from the course that the professor wanted to convey. But here again the professor has absolutely no idea of what it is that he did that produced this effect (a good test of this might be to ask a professor to convey his secrets to others -- and then to test the results). Indeed, studies have shown that "the effect of style of teaching or teachers' characteristics on teacher-student relations or on the number of ideas absorbed by the students (i.e., teaching effectiveness) is uncertain." (Berelson, p. 440)

In this light, our project may well be called a quest for certainty. The trouble with using such a grandiose designation is that it makes our accomplishments seem infinitesimal. Nonetheless, it does define our intentions.

One might well wonder why traditionally the students themselves have not been asked the kinds of questions here described. One can only guess that the absence of such queries signifies either obliviousness or certainty born from ignorance. Most professors probably do think that they are teaching something, and that they have devised fairly accurate measures of determining what it is they are teaching. It is doubtful whether they have ever seriously entertained notions of testing alternate ways of teaching the same material, based on feedback they could get from students. And even if they did, how would they get, and more importantly, perhaps, use, such information? Surely, Mark Hopkins got instant feedback from the other end of the log, and could alter his teaching style until he could see that the results he desired were obtained. But if there were two people at the other end of the log, he would have to gauge changes in teaching that would satisfy both -- not an easy demand. And multiplied by 20, 40 or several hundred, it reaches preposterous dimensions. The solution, of course, is compromise, probably what most professors feel they have done. How this compromise affects their students is, as has been pointed out, only indirectly and inadequately observed.

Natural Sciences 130 is an experimental Harvard course, a survey entitled "Communications in Societies." The staff aimed to give each student maximum freedom in the ways in which he could respond to the course. No specific subject matter was assigned, although reading for lectures was termed "required". Pass/fail or graded was a student option. There were two written requirements: a project, which would represent some independent work, in any medium, done in any area of interest to the student, and a diary, which was specified to contain notes and reactions to any reading done, projects notes and anything else deemed relevant.

The diary, we felt, provided us with a unique source -- testimony from each student -- for attempting to answer some of the questions outlined at the beginning of this paper.

First of all, we set out to determine what indeed did happen during the course. More explicitly, (1) from the point of view of the student: what did the course lead him to do? What aspects of the course -- what lectures, reading, staff, media, or other activities -- interested him? How much time and interest were invested in the course? What did he get out of the course in terms of knowledge? In terms of personal involvement and growth? (2) From the point of view of those offering the course: What were the successful and what were the unsuccessful aspects of the course? It can readily be seen that (2) could well be the aggregate picture derived from a thorough analysis of (1). And indeed, this is the point. If we could say what happened -- and eventually why that happened, we might be able to say not only what parts of the course were most valuable, what least valuable, but also why, which would give us some clue to help direct changes that could help make the course better do what the staff intended.

We soon found, however, that the diary itself was not sufficient to answer our questions, and we decided to send out a questionnaire which would more directly elicit the information we were seeking. (And we eventually found that very few, if any, of these questions have straightforward answers.)

Our conclusions, then, from this first analysis of the course, were derived, essentially, from three sources: the diaries, the questionnaire, and observation and interaction with the students.

Let us examine each of these sources separately.

THE DIARY

What sort of a measure was the diary?

As can readily be seen, it was an expressive document of sorts -- one in which the student could pretty much write what he wished about the course and the activities going on in the course. At the same time, he must inevitably have been aware of the fact that the staff would read his diary, a fact which might well have biased his expression. Different people were effected by this fact in different ways. Some expressed ambivalence, some seemed to forget the course-bound nature of the diary, and freely described events, feeling and emotions that would occur to them while writing (the simple fact that "some people are much more interested in expressing themselves than others" [Festinger, page 307]) -- and others used this vehicle mainly as a log book in which to record specific reading they had done for the lectures and the diary.

The problem for the researcher is obvious. As Festinger says, even when people are picked and asked "to produce documents to order -- which is the best procedure to ensure representativeness -- the probability that they will all perform the task satisfactorily is very small."* (page 307)

In order to get information out of the diaries in a form that would give us some sort of general picture of the ways in which the course affected the student in it, we formulated specific areas of inquiry, asking ourselves simply "what happened" and "why"? We wanted to know what responses the students gave to lectures, and specifically, whether the response was to the substance, the lecturer or the medium used. We wanted to know whether the student had been prepared for the lecture before it was given -- by assigned course reading, or previous knowledge -- or whether they came in cold. What effect did these different degrees of preparation have? What reading was done, and how useful was it to the student? How did the student choose his project? Did he feel he got anything out of it? Did he become personally involved in the course through the people -- staff, other students? We had been told by several students after the course was over that we should have held small sections in addition to the lectures. Did people feel this lack enough to comment on it? Is there any indication that these people were the same ones who took an active part in class discussions, or were they the ones who were "lost"? Etc. (See form, Attachment A.)

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* Perhaps satisfactorily is not quite the right word. The rather loose specifications for the diary renders many of the less informative ones still within restrictions. And of course, the trade-off for tight specification would inevitably mean that the student is even more conscious of, and therefore, more likely to be biased concerning the intentions of those who will review his material.

As might be expected, it is difficult to formulate questions for which one can anticipate finding a significant number of answers in such disparate documents. One cannot, for instance, ask: What lectures did the student attend? but only "what lectures did the student comment on?" (What then, can be inferred about the lectures he didn't comment on? That he didn't go? That he was too lazy to write? That he was too involved, and thought writing would be a pain? That he simply forgot?)

In sum, the student's actual behavior was not documented in his diaries, but only his verbal interpretation, which is a very different thing, albeit valuable.

So we found, hardly to our surprise, that the yield was low. Some diaries contained answers to many of these questions. Many contained none at all. The picture, therefore, that can be painted of the course from analysis of the diary is one which must be entitled "What people felt moved to say." Much of our analysis, then, must bear this caveat in mind. But this is not to say that the findings were worthless. It was simply not in the nature of the raw material to make them "complete". This was only a small first step in converting "recorded raw phenomena into data which can be treated in essentially a scientific manner so that a body of knowledge may be built up." (Festinger, page 429)

Another section of this report deals with the information gained from the diary. My project is primarily concerned with information obtained from the questionaire.

THE QUESTIONNAIRE

Festinger suggests that the value of documents such as the diary lies in their ability to highlight significant variables and hypotheses about these variables which can then be tested by other means. Also, "just because they are not dominated by the conceptual scheme of the investigation, they constitute an excellent check on data obtained by other means." (page 306)

Realizing that the diary represented the point of view of the student while the course was being held, we could not hope to ask students to fill in gaps from that perspective after the course was over. By definition, any questions asked at this time would be *a posteriori* views on the course. So whatever clarification we sought would have to come from this perspective.

The diaries, we discovered, told us almost nothing about what the student felt he *got out* of the course. In some cases we could tell whether he enjoyed different parts of it, whether be followed up lectures with independent reading or a project. But we could not tell whether he felt the course was beneficial to him, and why. We also could not tell, save in a few instances, what factors about the course and himself led to his enjoyment or disgust. This is different from asking what lectures he enjoyed -- it gets into the question of positive and negative motivation.

The questionnaire (Attachment B) solicited information of this sort. It was designed with both "closed" (3,4,7,8,) and "open and closed" (1,2,5,6,) questions. Briefly, the literature states that open questions generally ask people to recall information, while closed questions ask them to recognize information (*Handbook of Social Psychology*, page 458). Thus, in question number 4, for instance, it is possible that people checked factors which might only have occurred to them on seeing this possibility. Misunderstanding is more easily concealed with closed questions than open ones: a free answer will more likely show up ambiguities in the way the question was stated. Finally, and obviously, coding free material is costly and time consuming (a factor that applies as well to the diaries).

The literature contains much on wording of questionnaires. The concern is mainly with: 1. identifying the specific areas of concern to a diverse population and 2. avoiding ambiguity. (HB of Social Psych., p. 456). Only the latter pertains to this case and we seem to have done quite well judging by the nature of our responses (see below). As for the order of the questions, we seem to have, in our naivete, constructed a combination of a "funnel", (general - specific) and a "reverse funnel" technique (specific - general) either one of which is recommended. (HB, p. 459)

Our somewhat bumbling, intuition-guided techniques produced some interesting results. Of the 64 questionnaires returned out of a possible total of 104, only ten were incomplete -- six of them leaving their names off. (Four people got lost at other points in the funnel). We were able to match four of these people with handwriting in the diaries, giving us a total of 62 questionnaires to work with. This turns out to be a pretty good showing. According to Kerlinger (p. 377), "Responses to mail questionnaires are generally poor. Returns of less than 40 to 50 percent are common, higher percentages are rare. At best, the researcher must content himself with returns as low as 50 to 60 %." He warns against making generalizations based on such a sample, stating "every effort should be made to obtain results of 80% or 90% or more, and lacking such returns, to learn something of the characteristics of the non-respondents." Here we could feel quite safe. We had 60% return and we had additional information -- the diary plus our own knowledge of many of the non-respondents to go by.

Personal Knowledge of the Students in the Course

This factor gives the study some of the flavor of participant observation. It should be made clear, however, that we did not combine subjective judgments with objective data from students. This knowledge helped in the initial stages of designing diary questionnaires and in the final stage of assessing the non-respondents in order to get some sense of the representativeness of our sample.

Problems of Collection and Analysis

The chief problem in getting material from the diaries was that of uniform coding. Professionals have apparently made a science of this, checking and double checking to make sure every coder is doing the same thing. We were not so careful, and a scrupulous researcher would undoubtedly raise eyebrows at some of the discrepancies. A word to the wise for anyone thinking of doing this again: just after filling in the first handful of blanks -- get together and discuss the problems.

Once the data had been collected, the chief difficulty which we encountered was in deciding how to analyse it. What factors should we try to correlate with which? Because this data had not been computerized, it was not possible to test out correlations with many different variables. We simply had to rely on common sense to guide our efforts. As Lazarsfeld says (p. 83)

> Before we can investigate the presence or absence of some attribute in a personal or a social situation, or before we can rank objects or measure them in terms of some variable, we must form the concept of that variable. Looking at the material before us in all its richness of sense-data, we must decide what attributes of the concrete items we wish to observe and measure: do we want to study "this-ness" or "that-ness" or some other "ness"? The precise origin of our notion of this-ness or that-ness may be extremely varied, but it usually seems to involve combining many particular experiences into a category which promises greater understanding and control of events."

It is remarkable how sensitive Lazarsfeld is to the situation we were in. He goes on to say (p. 83-84):

> It happens that research does not always begin with general theoretical categories and theoretically described relations among them. At the present stage of the social sciences a great deal of research must be of an exploratory nature, aiming at qualitative answers to such questions as ... what goes on in a certain situation? [etc. ...] The immediate problem is to get the raw data classified in some preliminary way, so that it can be communicated, cross-tabulated, and thought about."

Lazarsfeld (p. 84) then gives an extremely helpful system to aid in the classification of "free responses". I shall discuss this system in the light of my own analysis of the questionnaire.

> "1. Articulation. The classification should proceed in steps from the general to the specific, so that the material can be examined either in terms of detailed categories or of broad groupings, whichever are more appropriate for a given purpose."

This is essentially what I have done. My most important, broadest category is "Degree of time and interest in the course." From here, I have broken the group down in several other ways: grades; how attitudes toward science and technology were affected; follow-up to the course; positive and negative factors weighing on the individual's response to the course. The smallest grouping was by major field (Freshman, Natural Sciences, Social Sciences, Humanities, other).

> "2. Logical Correctness: In an articulated set of categories those on each step must be exhaustive and mutually exclusive. When an object is classified at the same time from more than one aspect, each aspect must have its own separate set of categories."

The broadest category "Degree of time and interest in the course" has, indeed been broken down into mutually exclusive units: high interest and time and low interest and time. The few exceptions will be accounted for below. The other categories seem also to meet this criterion, as will also be seen in the ensuing discussion.

> "3. Adaptation to the structure of the situation: The classification should be based on a comprehensive outline of the situation as a whole -- an outline containing the main elements and process in the situation which it is important to distinguish for purposes of understanding, predicting, or policy-making."

While I feel that our analysis is "adapted to the structure of the situation", this is undoubtedly an intuitive feeling. The difficulty here is that the "structure of the situation" is to begin with, not truly clear; indeed, our efforts have been in a sense to define that very structure. The classification system was one attempt to get at that structure -- simply by declaring these items "the main elements and processes in the situation," we have hypothesized, for instance, that time and interest determined to some degree what happened to a student in the course.

Lazarsfeld insightfully labels efforts such as ours "trying to classify 'reasons' for certain kinds of action." (p. 87). He states that such efforts must indeed start by building up a concrete or model of the whole situation to which the reports refer, and then locate the particular report within this structural scheme.

> "4. Adaptation to the respondent's frame of reference: The classification should present as clearly as possible the respondent's own definition of the situation -- his focus of attention, his categories of thought."

This is precisely what I feel has been done. I have taken care to devise categories that make sense from the point of view of the students -- the clearest example of which is the "time and interest category" which was divided not by our judgments of high and low, but from within the student's own world. That is, the designation depended not upon absolute time spent or interest, but upon where he put his own priorities. (See question 3 on the questionnaire.)

Let us now turn to an analysis of the findings.

Validity of Diary

The diary findings have been analyzed earlier;* I will not go over them here. The one aspect I would like to treat, however, is that covered in question 5 of the questionnaire. For here we were trying to get some sense of how much we could trust the information contained therein. Chart #1. summarizes this information. It says essentially that over half the respondents felt that the diary was not fully representative either of their work in, or of their attitudes toward, the course. Over twice as many said "no" to the attitudes question than the work question. A review of the reasons for the "no" and "sort of" responses reveals the following:

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* See Appendix VII

1. As to work done: when explanations were offered, they indicated that much had been left out; more reading and more thought had been done than had been recorded.

2. As to attitude: some people didn't realize we wanted these; some simply didn't find this a good medium for expressing such opinions. As one student said, "I wasn't motivated to put criticisms on paper."

What, then, are we to make of the diaries? We could take two points of view:

1. "Subjects who consciously dissemble during an experiment may do so afterward for the same reasons. And those who are unaware of the effects of the research may hardly be counted on for valid reports afterwards." (Unobtrusive Measures, p. 16). This would lead us to a quagmire of doubt as to how many people were actually doing as much work as they claimed and telling us exactly what we wanted to hear.

2. To believe what they said -- namely, that on the whole, the diaries are accurate, but not complete, in the amount of work they report the student as having done; and that the attitudes, while somewhat less straight forward, fall in the same boat.

I suppose it is the better part of valor, common sense and sanity to opt for the latter with a somewhat cautious eye on the possibility of the former where such cases might crop up.

Validity of Questionnaire sample

How were the 62 questionnaires distributed over the range of the class? Was it representative? of what? Who didn't answer the questionnaire?

Chart #2 analyses the grade distribution of respondents. The total shaded-in area represents the total number of respondents in that category; the unshaded area, the number of non-respondents. It can readily be seen that our sample is quite representative of all grades -- three (A, B, Pass) being 60 ± 2% represented, and C, 75%. Our showing in the D and failure category was expectedly low: neither the D nor F responded and only 1 of 5 E's. So if we were concerned with having a fair sampling of the grade distribution, I would sa that this has been reasonably well accomplished. Chart #5 shows that the responses were proportionally evenly distributed over major fields, except for the humanities which was somewhat under-represented.

What about distribution in terms of "time and interest"? As can be seen from the same chart (#2), the distribution of our sample split evenly between those of high and low interest. What about the non-respondents? Since this measure was so subjective, it is a particularly treacherous one to estimate. Our treacherous, educated guess based on diary analysis of the non-respondents, then, was that the non-respondents were distributed in about the same manner, 50-50. We are inclined to believe therefore, that, save for the six people who got below C and did not respond, our sample was surprisingly representative.

High and Low Interests

1. What is the purpose of this category?

I felt that the most interesting question to ask about the students in the course was "who got involved in it, and why?" The importance of this question is based on the assumption that involvement is a function of the desire and ability to get into a subject, and that involvement generally secures the benefits -- personal and intellectual growth -- for doing so. If we could determine who did and did not get involved we might be able to say something about why, and what the consequences were. We might then be able to better design the course next year to involve more students.

2. How did we determine who was "high" and who "low"?

Question #3 on the questionnaire was our gauge. At first, I divided the group into: 1) those who answered 2 or 1 for both time and interest and 2) those who answered below 2 for either. This seemed to be a fair division, save for five people, four who answered 3,1 and one who answered 4,1. Rather than create a separate category for these people I decided to put them into the high category; they did have high interest after all (no others now left outside this category gave a "1" for interest) and so were probably as involved as they were in anything else last semester.* Note that this categorization is not an absolute measure. A student for whom the course ranked 4th in time and/or interest might have spent as much time and been as interested as one for whom it ranked 1st. The category merely reflects personal priorities.

3. How valid did the high-low interest category prove to be?

A glance at chart #2 will show that high and low interest was clearly not a factor in the staff's assessment of student work. The split in each grade category for which we have more than one representative (that is, A, B, C, Pass) shows a near 50-50 split in all cases. This then, does not show up enough of a distinction to justify the category.

One would expect the high-low distinction, which in some way represents personal input, to be reflected in personal output, if you will. Thus, it would seem logical to look for differences between these two groups in 1) whether they would take the course again and 2) whether they responded to one of the main thrusts of the course: imparting a balanced outlook on science and technology. Chart #3 shows the number of people who said they would take the course again. Of the high interest people 28 said yes, 2 no, 1 undecided. Of the low interest, 18 said yes (!), 5 no, and 7 were undecided. In other words, of the 15 people who said no or were undecided, 12 were low interest. Now let's look at Chart #4. If we consider both "positively" and "negatively" as part of a single category, "Those for whom S and T in the course had an impact," 25 high interest and 21 low interest are included here. The remaining 15, whose outlook was unaffected, are divided 2/3 low interest and 1/3 high interest.

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*For brevity, I will generally refer to these people as "high and low interest".

The answer to the question of the validity of the high/low category, then, would seem to be somewhat equivocal. A very large number in both the high and low interest/time categories were affected by the course, although there were more lows than highs that weren't. Thus, the category, while not invalid, would seem to be of limited usefulness in pointing up differences but of some help in indicating very interesting similarities among all students taking the course. The remaining discussion will highlight this fact.

4. What were the academic characteristics of each group?

We've already looked at the breakdown by grade. Now let's turn to a breakdown by major field (chart #5). Here we see that the major group with the proportionately largest number of low interest people was the humanities. A further breakdown by grades pinpoints another trouble area: Social Science Pass/Fail. Here, of the 12 respondents, 8 were low interest.

Almost 1/2 the low interest people, then, were humanities, or Social Science P/F. In any other group, there was a 50-50 or better chance of being high interest (exception -- there always is one -- Nat. Sci. A: 2 low, one high!) The categories containing more than two people with a high proportion of enthusiasts were Freshman A's, Nat. Sci. P/F.

5. What factors might have accounted for this division of students?

Here we must be very careful of the distinction between correlation and cause-and-effect, a problem which runs throughout this study. To say that a person said x, y, z, were the positive factors, and a, b, c, the negative factors affecting his involvement in the course really hedges concerning whether: 1.) the person believes abc and xyz because he was involved to the degree he states, or 2.) his level of involvement caused his belief that abc and xyz. Some introspection is likely to yield the answer that there probably is some of each mixed in here.

Bearing this caution in mind, let's turn to Charts #6 and #7. There we see the positive and negative factors (not weighted by ranking, since many people didn't bother to rank) which the students felt affected their involvement in the course.

On the positive side, it would appear that there is little difference between the groups. The categories given the highest overall selection, _a_, _d_, _k_, and _m_ (_a_ and _d_ dealing with content, _k_ with the project, _m_ with staff) were also the highest items for both the high and low groups alone. The only categories where the low group outstripped the high were _f_ (personal life good!) and _k_. Categories with differences of more than 3 were _e_ (experimental format), _l_ (independent reading) and _m_.

A profile one might wish to draw from these charts would be the degree to which the staff was important in determining a person's involvement. If we look at m, we can see a noticeable difference (6) between high and low interest. It is possible however, to argue that a reflects the strength and likeability of the staff also, in which case the difference lessens somewhat. (The fact that all but 5 [2 high, 3 low] of the 38 people who checked m also checked a would support the hypothesis that they have a similar root.) a and m, between them, in fact, account for all but 4 of the highs and 6 of the lows. Of these, 2 high and 2 low said k (liked project) only, 2 low said l, (independent reading) only. The other 4 were erratic. This would suggest the course was generally enjoyed by all, at least at some point, and that a good many people did not have to put much into it in order to enjoy it.

Let us look at the negative factors (chart #7). Differences here are more notable. Of the 94 negative comments, 58 were from low interest people. The notable overall factors seem to be a, and i first, then c, d and j. However, in only two did the high interest people total more than 5: d (bad personal life!) and i (diaries are a pain). Low interest people, on the other hand went over 5 on a, c, d, i, and k, with the widest gaps between the two on a (superficial content), i, and k (too much freedom, not enough structure). This suggests to me that many more low interest people than high simply had a hard time figuring out where they should "dive in" and whether they could swim if they did.

k is of particular interest to me for two reasons. 1) There has been much talk about this problem in Nat Sci 131, and it is fascinating how few people checked it. Is one to conclude that it wasn't a factor, or that people just didn't recognize it as such? 2) It is the item with the greatest proportional difference between high and low interest, 6:1. This would suggest that the problem bothered those who were involved much less than those who weren't (in fact, the one high who checked this was a borderline 3-time 1-interest case).

6. What did high and low interest/time have to do with what a person got out of the course?

Let's look at charts 3 and 4 again. #3 indicates that many more high interest people than low got enough out of the course to know that they would do it over. #4 shows that slightly more high than low interest people changed their views (all but 5 positively) on science and technology, while twice as many low people as high were unaffectedd.

It is indeed surprising how many low people apparently were affected by the course. A total of 24 chose one or more of the three: 1) S and T outlook affected; 2) take course again; 3) follow up activity (chart #9), which indeed, leaves us with only 7 left entirely unaffected by the course! Of the high interest people, there was no one who fell in this category.

See Attachment C for a list of the ways in which people claim to be following up.

7. Is there any way to characterize the seven people on whom the course had no impact?

Charts #8, 9 and 10 give us some idea. Chart #8 shows the distribution of high-low people according to their S and T outlook and whether they would take the same course again. Of the highs, not-at-all group, all would take it again. Of the lows, not-at-all group, 3 would, 7 would not. Chart #9 tries to locate students as to interest, S and T outlook and follow-up activity. Here we can see that of the 30 people who indicated no follow-up, 17 were low interest, of which 10 claimed not to have had a changed outlook on S and T. In fact only in the low interest, not-at-all category did all people indicate no follow-up.

Sight must not be lost, however, of the fact that 13 high interest people indicated no follow-up. And of the people in the "positively" category, 26 indicated follow up, of which 13 were high and 13 low, and 15 indicated no follow-up: 9 high and 6 low. The conclusion must be, therefore, that whether a person was high or low interest, there was equal chance of follow-up -- save if a person was low-interest and was not "tuned in" to the S and T aspects of the course. Then, the chances of follow-up were nil, although about one third (3 of 10) indicated they would take the course again.

Chart #10 shows the distribution of high-low interest by S and T outlook, grade, and major field. The low interest not-at-alls on S and T are enclosed in squares. Recall that the humanities (chart #5) had the greatest proportion of low interest people. Yet, none of them fell into the low-interest not-at-all group. 7 out of the 10 fall in the social sciences (B (2) and P/F (5)) group, 2 are freshmen, (1B and 1C) and one a Nat. Sci. A. Three of the Soc. Sci. group (the 2 B's and 1 P/F) said they would take it again.

What more can we say about these seven people who appear to have been entirely unaffected by the course? First, their names, year, major and grade:

Peter Shapiro	Fr.		C
Larry O'Donnell	Fr.		B
James Fitswilliam	Soph.	Astro.	A-
Roslyn Daum	Sr.	Gov.	P
Kala Ladenheim	Jr.	Psych.	P
Lucinda Winslow	Jr.	Hist.	P
Richard Stratton	Jr.	Hist.	P

All three of those who were graded were taking the course as a Gen. Ed. requirement (of the 24 people who claimed this reason for taking the course, 6 got B; 5, A; 13, C). Only two indicated confusion with the early math lectures. None, save Fitswilliam, seems to have gotten to know the staff more than perfunctorily. As for the projects, it is interesting to note that 5 of the 7 seem to have chosen projects lying within their major field of interest (the two freshman, of course, have no field). Of the high-interest people, the ratio was over 2:1 in favor of unrelated projects. Among the low-interested it was approximately 50-50.

A breakdown of their choices on the positive-negative factors looks like this:

Positive	Negative
a-2	a-5
b-1	b-1
c-0	c-2
d-2	d-1
e-2	e-0
f-0	f-0
g-1	g-1
h-1	h-1
i-3	i-3
j-0	j-0
k-4	k-1
l-2	l-0
m-1	

A brief interpretation would be that these people did not particularly like the staff or the way they handled the course (although no one checked l negative, 3 total checked a and m positive) and that the little if anything they did manage to get out of the course was completely on their own (positive k and l) and apparently not very satisfying since they wouldn't take the course again. Note that only one person checked one of the two "personal life" questions -- negatively, thus being the only one who might have been willing to blame outside factors for his problem!

Conclusion

1. From our level of analysis people seem not to have gotten out of the course what they put into it. Regardless of whether a person devoted high or low interest/time to the course, he might still want to take the course again, might be following-up what he learned with projects, other courses, or career plans, and might have a new outlook on science and technology. Unlike many college courses, then, it would seem that just by "being there", so to speak, a student might have profited.

2. Ten people fell in the group of low interest people whose outlook was unchanged by science and technology. Of the ten, three said they would take the course again, but, like the rest, indicated no follow-up. This leaves only seven people who, by our criteria, were entirely unaffected by the course. These people did very little work (with the possible exception -- unless we were conned -- of the A-) and did not seem to care for the staff at all or the way the course was conducted. The three who were graded were taking the course for a Nat. Sci. requirement. It would seem that getting something from the course would demand either a commitment of time and interest or a desire to get into the science and technology aspects of it, or both.

3. A total of all but 10 people seem to feel that the staff and the "broad range of interesting topics" factored significantly in their interest in the course, a fact which throws some doubt on the "packagability" of the course (if one assumes that "broad range of interesting topics" is dependent on the staff -- sort of a knotty problem).

4. What, if anything, does this suggest for next year? The very division into high-low interest/time is an a posteriori one that was convenient for analysis but probably cannot be directly measured early in the semester. It should be noted that even though many of these low-interest people did manage to get something out of the course, they still had a reason for making it lower on their priority list than other courses, and might well have gotten more out of the course had they wanted to. It should be remembered that as a group, more of these people (than high interest people) felt the course was too superficial and not structured enough. And those with the most problems did not get much out of the science and technology aspect of the course.

a. One possibility, it would seem to me, of early detection would lie in sending out feelers (short questionnaires, probably during the class) to discover the people most troubled by such problems*. They should then be encouraged to come to a section (which would probably be in considerable demand) which would deal with these problems and questions they have. They should be asked to think about possible connections in the course, and asked to convene with others (including staff) who might want to discuss this. If enough people indicate at the end of a lecture that they would attend a further section on the topic, a section should be held. And finally, much encouragement (even "formal" blackboard invitations) should go out to those having trouble with the S and T topics.

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* Note that the evidence does not support making the course more structured. Many people, most in fact, liked it that way. Some extra curricular way to satisfy the unhappy would seem to be as far as we should go.

b. Projects should be thought about early, and people encouraged to venture into new territory.

c. Lectures can be improved in some specific ways, as diary analysis has shown.

d. Finally, to facilitate data collection next year, it would seem to be that there should be somewhat more guidance on the diaries. Students should be encouraged to include some comment on the various aspects of each class meeting (content, lecturer, media), and it should be made very explicit that this will in no way reflect on their grade. It might be mentioned that we value personal reactions much more highly than rote copying because we feel both we and they profit most from a questioning, critical outlook. And if they find they are highly critical of the course in the diary, they should discuss this with the staff.

It would be very interesting if students were asked to include in their diaries a brief, but regular, account of their reactions to some other course they enjoy. This might give some control measures to our enterprise, particularly to such a relative guage as the high/low interest/-time category explored in this paper.

They should also note how they came upon the selection of their project topic, and give some indication of how satisfied they feel with it.

5. What about follow-up studies on last semester's group? A study in another year of these people would be most interesting. Some questions that might be asked:

- What, in your memory, was the most valuable aspect of the course?

- If you followed-up the course with another activity, what was it, and was it worthwhile?

- If you had it to do over, would you take the course again, knowing what you do now?

- If you were to take the course now, what would you devote your time to, and why?

- Has your outlook on science and technology been any further changed since the course? How?

- What do you think was most seriously missing in the course?

- Do you remember why you were or were not interested/involved in the course?

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ATTACHMENT A

Your name ____________________

Name: M___ F___ Year: ____________
Major ____________
P/F ____________
Grade ____________

I. COURSE REQUIREMENTS

A. Diary

-Confused about purpose? Yes No Na

B. Project

-Title ____

-Choice motivated by:

130 lecture 130 reading previous personal interest

another course staff suggestion desparation

-Student satisfied with finished product? Yes No Uncertain

II. READING

A.-On what basis were independent readings selected?

random concentrated topic interest

spurred by lecture or course reading

B.-In what area, aside from project, did student do most concentrated reading? ____

III. RELATION TO OTHER STUDENTS

A.- Was student generally aware of how others in course were thinking?

thought so, and felt they shared his views

thought so, and felt they were at odds with him

no, but wished to

no, didn't care

B.-Did student get acquainted with staff?

only with regard to project more extensively than/just through project

no

III. (cont'd)

C.- Did student (circle if yes; 'x' if no; blank if na)

attend at least one J.J. dinner   attend before and after class activies

become acquainted with other students   participate in class discussions

remain aloof   seem intimidated

IV. SECTIONS

A.-Interest expressed in having sections?   Yes   No

B.-Reason wanted sections:

to hear and discuss student opinions

to get to know staff and class better

to go into subject matter in greater depth

to explore new topics not covered in lecture

V. GRADING

A.-Why chose grading status he did:
(if graded):
fulfilled necessary Harvard requirement

liked good grades: as ego-booster
as self discipline
for academic record

(if p/f):
didn't want pressure

disapproves of grading system

B. -Thinks course, in future, should be:

only p/f   only graded   same   self graded

VI. EFFECT OF COURSE

A.- Did course affect opinions on science and technology?   Yes   No

How(briefly)? TAB!

B.- State briefly other effects & TAB :

VII. COURSE IN HARVARD CONTEXT

-Did student think course

Not very different from any other Harvard course
- if so, any specified?______________________________________
Ineffectual attempt to get away from traditional course structure

Stimulating departure from regular routine

VIII.-Any suggestions on further subject areas to be covered?

Student Name

IX Lecture Topic	Notes	Student familiar w/topic	Reaction to Lecture	Reaction to:				Follow Up	Reading re Lecture
				SCHEDULE	LECTURER	MEDIA	CLASS DISCUSSION		
Intro (AGO)									
10/1 (BB) Shannon-Weaver									
10/6 con't Bit Theory									
10/8 (AGO) Telephony walk-thru									
10/13 (AGO) Linear Amplifiers									
10/15 (Panel) FCC-ATT Dockets									
10/20 (AGO) Transmissions									
10/22 (AGO) Compunications									
10/27 (AGO) EducTech&Innov.									
10/29 (BB) Birds,Bees,Frogs									
11/3 con't Ants & Sex									
11/5 (JP&AF) Computer Survey									
11/10 (DL) Visual Perception									
11/12 (BS) Sense Perception									
11/17 (DL&BS) Theatre Comm.									
11/19 (Panel) ESP									
11/24 (AGO) Linguistics									
12/1 (BB) Hermit Crabs									
12/3 (BB) con't Dominance Theory									
12/8 (Zartler) Business Organ.									
12/10 (Zapol) Tech&Third World									
12/15 (Gerade) Class Evaluation									

READING

A. Mark:

1. Read
2. Wanted to read but couldn't find
3. Stimulating
4. Discouraging
5. Boring

Weaver		Slime Molds	
ATT Docket		Information	
Pulse Code Mod.		Taviss	
Comm. Satellites		Cherry	
Tel. Switching		Miller	
IIA & EIA		Zartler papers	
Carey & Quirk		Solzhenitzyn	
Compunications		McLuhan	
Ransom		Langer	
Run, Computer, Run		Suzuki	
Sebeok		Bruner	
Pheromones		Skinner	

B. Did he find any other Sci. Am. reprints particularly useful or interesting? Which ones?

C. Suggestions for further reading.

ATTACHMENT B

A group of us taking Nat. Sci. 131 are interested in some of your a posteriori thoughts and reactions concerning Nat. Sci. 130. Please fill this out and return in the enclosed envelope -- as soon as possible. Thanks.

Name ________________________________

1. Did Nat. Sci. 130 affect your outlook on science and technology?
   Positively Negatively Not at all If so, how?

2. As a result of Nat. Sci. 130, have you become involved in anything --- courses, projects, papers, future plans --- that you would probably not have considered otherwise? Yes No If YES, explain briefly.

3. Compared with your other courses last semester, Nat. Sci. 130 ranked (circle one for each):
   1 2 3 4 in terms of time spent in the course
   1 2 3 4 in terms of interest in the course

4. The following is a list of positive and negative factors we think might have affected your involvement in the course. If you can think of others, please add them. Then circle the items which applied to your case and number the three or four most influential factors.

Positive

____a. There was a broad range of interesting topics
____b. The content met your needs (personal; other courses; etc.)
____c. The course challenged you.
____d. The course introduced new ideas.
____e. The format was experimental.
____f. Your personal life was good.
____g. You wanted a good grade and thought you could get it.
____h. You like not working for a grade.
____i. The requirements were easy.
____j. You like writing diaries.
____k. You liked your project.
____l. You wanted a chance to do independent reading.
____m. You liked the staff.
____n.
____o.

Negative

____a. The content was too superficial.
____b. You weren't interested in the content.
____c. It was a bad experiment in format.
____d. Your personal life was bad.
____e. You get anxious about grades.
____f. You don't do much work for p/f courses.
____g. The requirements were too easy.
____h. The requirements were too hard.
____i. Diaries are a pain.
____j. Your project was an abortion.
____k. There was too much freedom; not enough structure.
____l. You didn't like the staff.
____m.
____n.
____o.
____p.
____q.

5. Was your diary an honest account of the work you did in the course?
a) YES b) NO c) SORT OF If (b) or (c), any comments?

Was your diary an honest reflection of your attitudes, feelings, reactions, etc. toward the course? a) YES b) NO c) SORT OF
If (b) or (c), any comments?

6. Why did you choose (check one) ☐ P/F ☐ Graded?

7. If you were graded, did you get what you expected?
Yes No Lower Higher

8. If you had it to do over, would you take Nat. Sci. 130?
Yes No Undecided

If you share our concern with improving the course next year, join us on Wednesdays at 2:00 pm. in Matthews Basement.

ATTACHMENT C

Comments Made on Follow-up Question

Yes

My general thinking about the state of things; career plans

Independent study with Dick Land this semester

Three courses I'm taking this semester and a personal experiment at home

Perspective on my Major

Research of high school educational systems

N.S. 131; computers

N.S. 131 Wednesday group

N.S. 131 and summer work

Future plans: computer applications

Expanded project on hitch hiking for SS 136, Social Character of America

The project affected my painting and I'm taking a year off to work on it.

N.S. 131

I will be more open to using technical aids for teaching

I plan a concentration in communications

Possible summer internship for 130

Considering N.S. 110

N.S. 131

N.S. 131

May take a similar course next semester

Language theory

Interested in education, not educational technology; have turned toward sociology and politics of education

N.S. 131; interest in education

General interest in AV, and want to do further creative work in sound systems.

Steered toward thesis advisor and topic

Interested in Buckminster Fuller's World Game; wondering about working in science education.

Interest in educational technology; N.S. 131

Extended interest in communication, language

Doing Freshman seminar paper on urban communications

Considering special major in communications

No

But made understanding of another course easier

	YES	NO	SORT OF	
HONEST ACCOUNT OF WORK DONE?	28	6	24	Omitted ④
HONEST ACCOUNT OF ATTITUDES?	26	15	18	Omitted ③

CHART 1 STUDENT ASSESSMENT OF DIARY

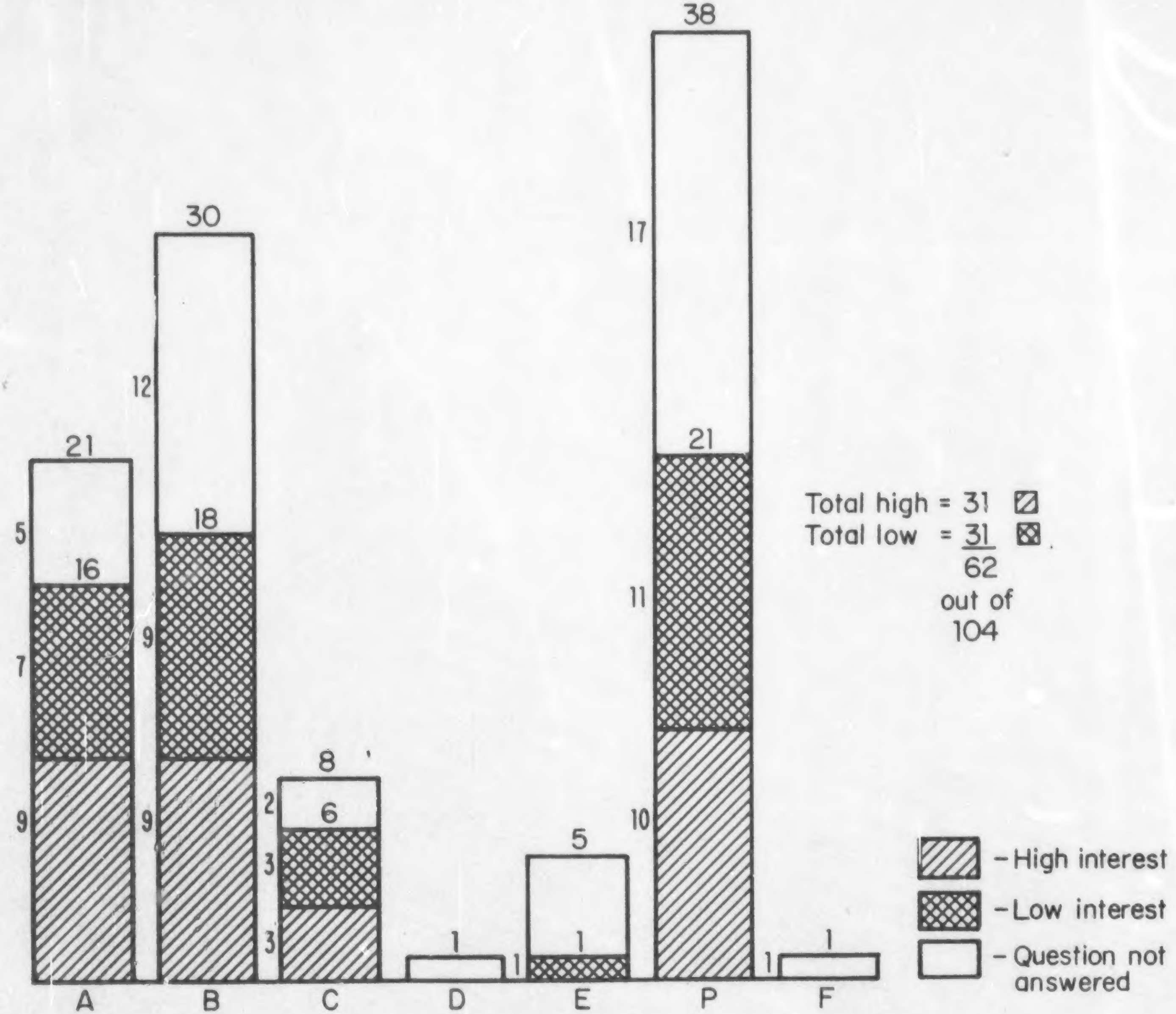

CHART 2 GRADE DISTRIBUTION OF QUESTIONNAIRES SHOWING HIGH & LOW INTEREST

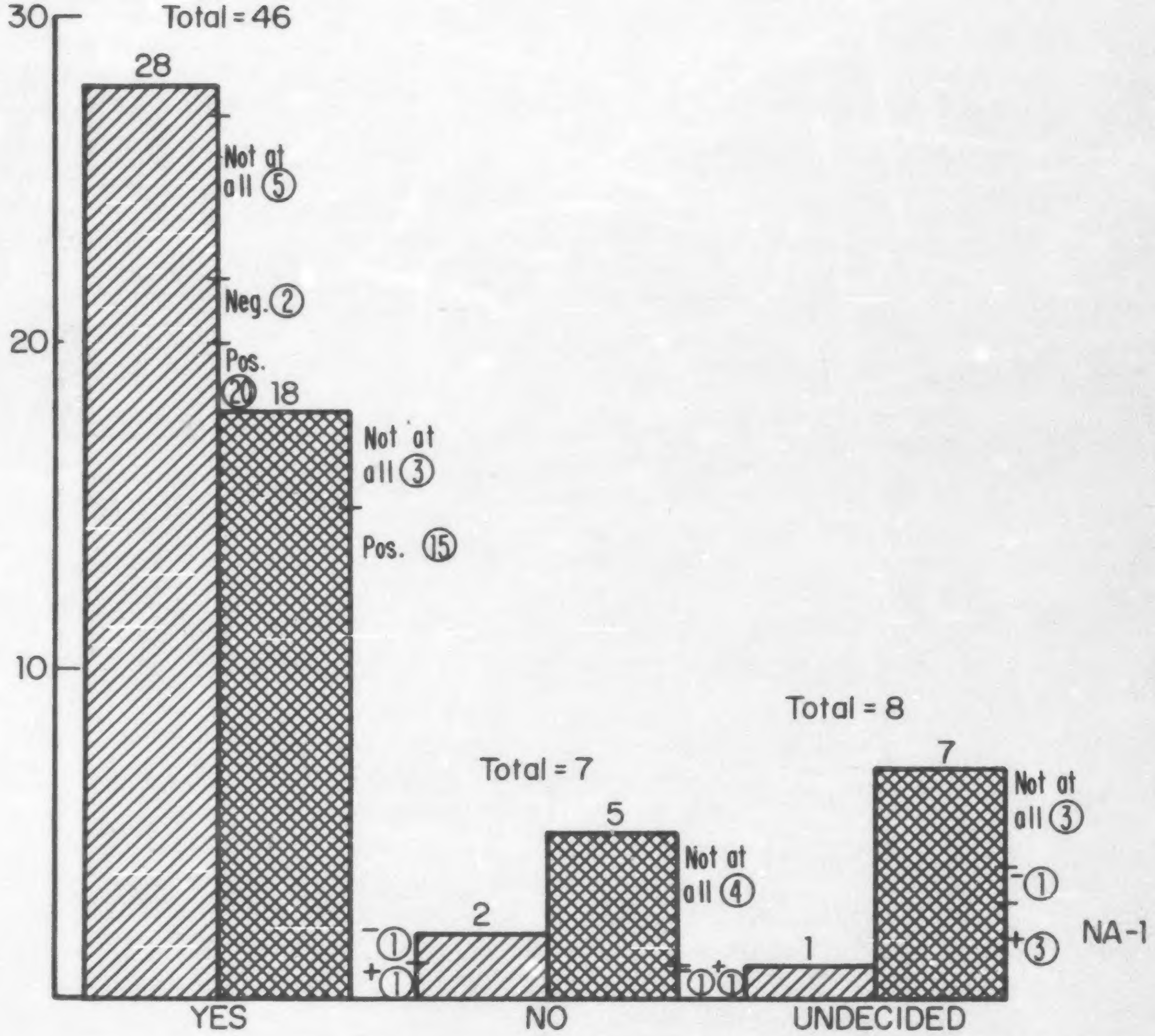

CHART 3 WOULD YOU TAKE THE COURSE AGAIN?

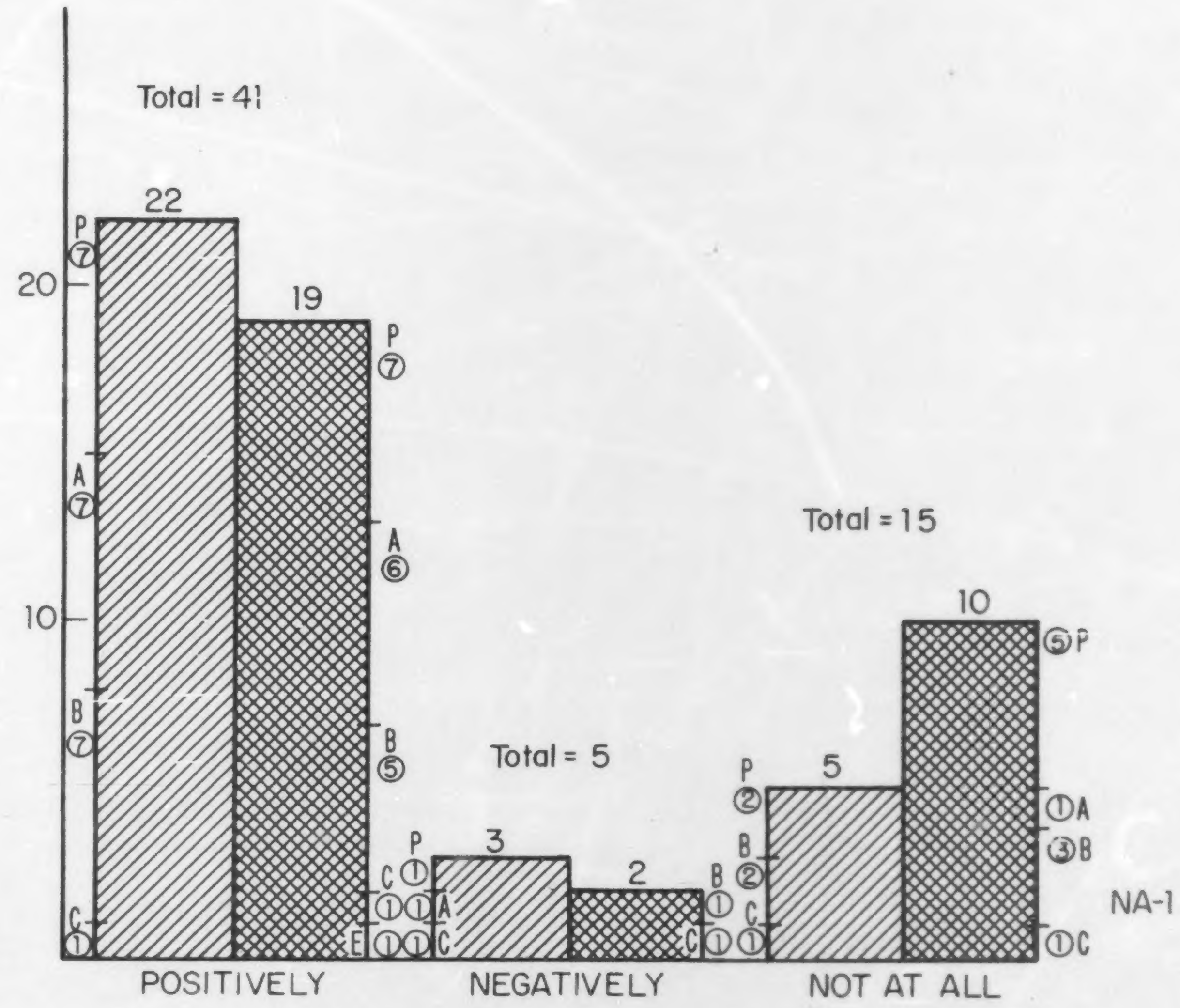

CHART 4 DID NAT. SCI. 130 AFFECT YOUR OUTLOOK ON SCIENCE AND TECHOLOGY?

	FRESH.	HUMANITIES	NAT. SCI.	SOC. SCI.	OTHER	TOTAL
A	7 7 } HI=5 LI=2	2 1 } HI=0 LI=I	6 3 } HI=1 LI=2	5 4 } HI=2 LI=2	1 1 } HI=1 LI=0	21 16 } H=9 L=7
B	8 4 } HI=2 LI=2	5 1 } HI=0 LI=1	1 1 } HI=1 LI=0	15 12 } HI=6 LI=6	1 0	30 18 } H=9 L=9
C	1 1 } HI=0 LI=1	4 3 } HI=1 LI=2	1 0 —	2 2 } HI=2 LI=0	0 —	8 6 } H=3 L=3
D	0 — —	1 0 —	0 — —	0 — —	0 —	1 0
E	0 — —	2 1 } HI=0 LI=1	1 0 —	1 0 —	1 0	5 1 } H=0 L=1
P	7 4 } HI=2 LI=2	6 2 } HI=1 LI=1	4 3 } HI=3 LI=0	21 12 } HI=4 LI=8	0 —	38 21 } H=10 L=11
F	0 — —	0 — —	0 — —	0 — —	1 0	1 0
TOTAL	23 16 } H=9 L=7	20 8 } H=2 L=6	13 7 } H=5 L=2	44 30 } H=14 L=16	4 1 } H=1 L=0	104 62 } H=31 L=31

CHART 5 QUESTIONNAIRE GRADE DISTRIBUTION BY MAJOR FIELD, SHOWING HIGH AND LOW INTEREST

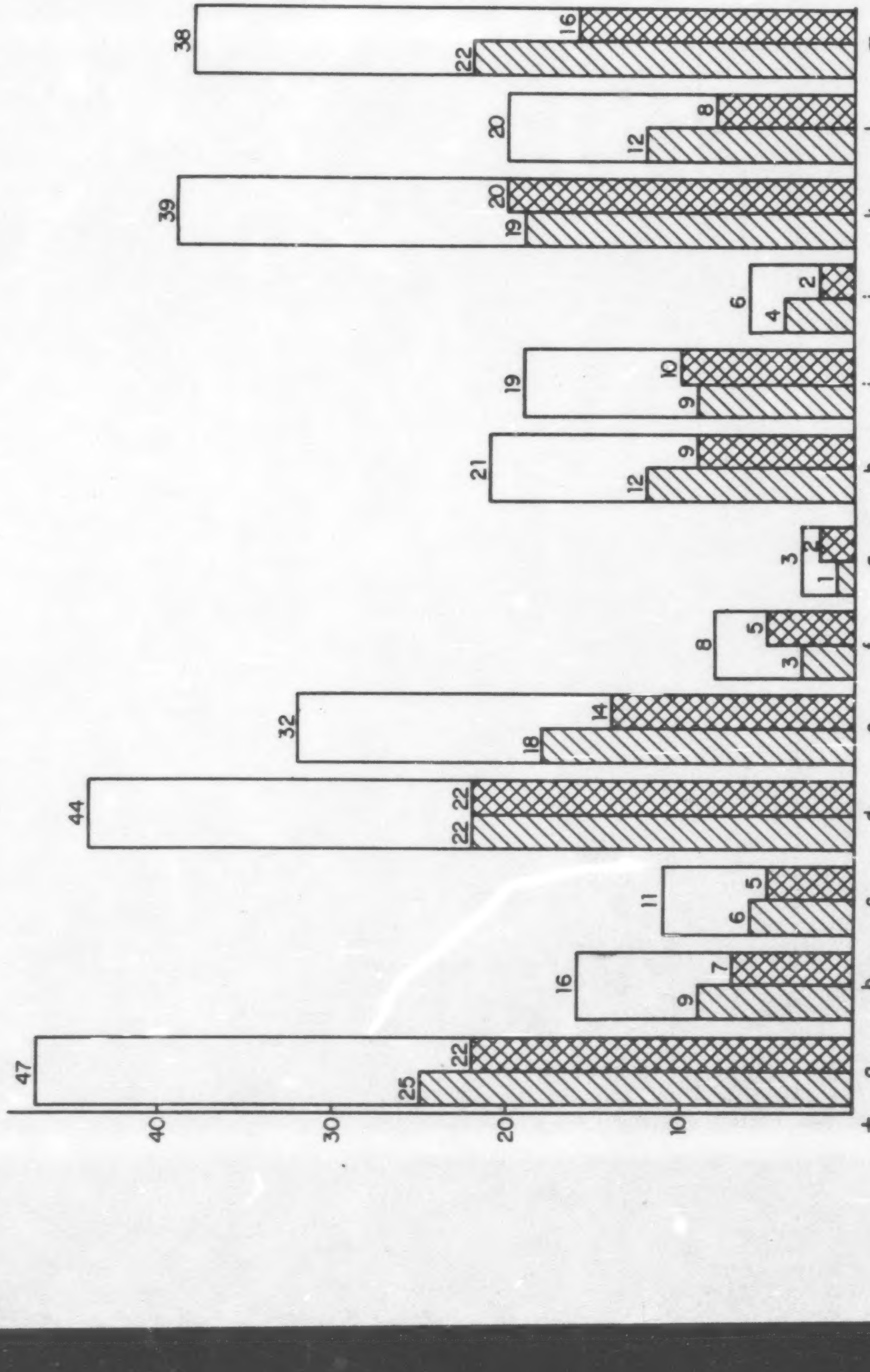

CHART 6 FACTORS INFLUENCING POSITIVE REACTION TO COURSE

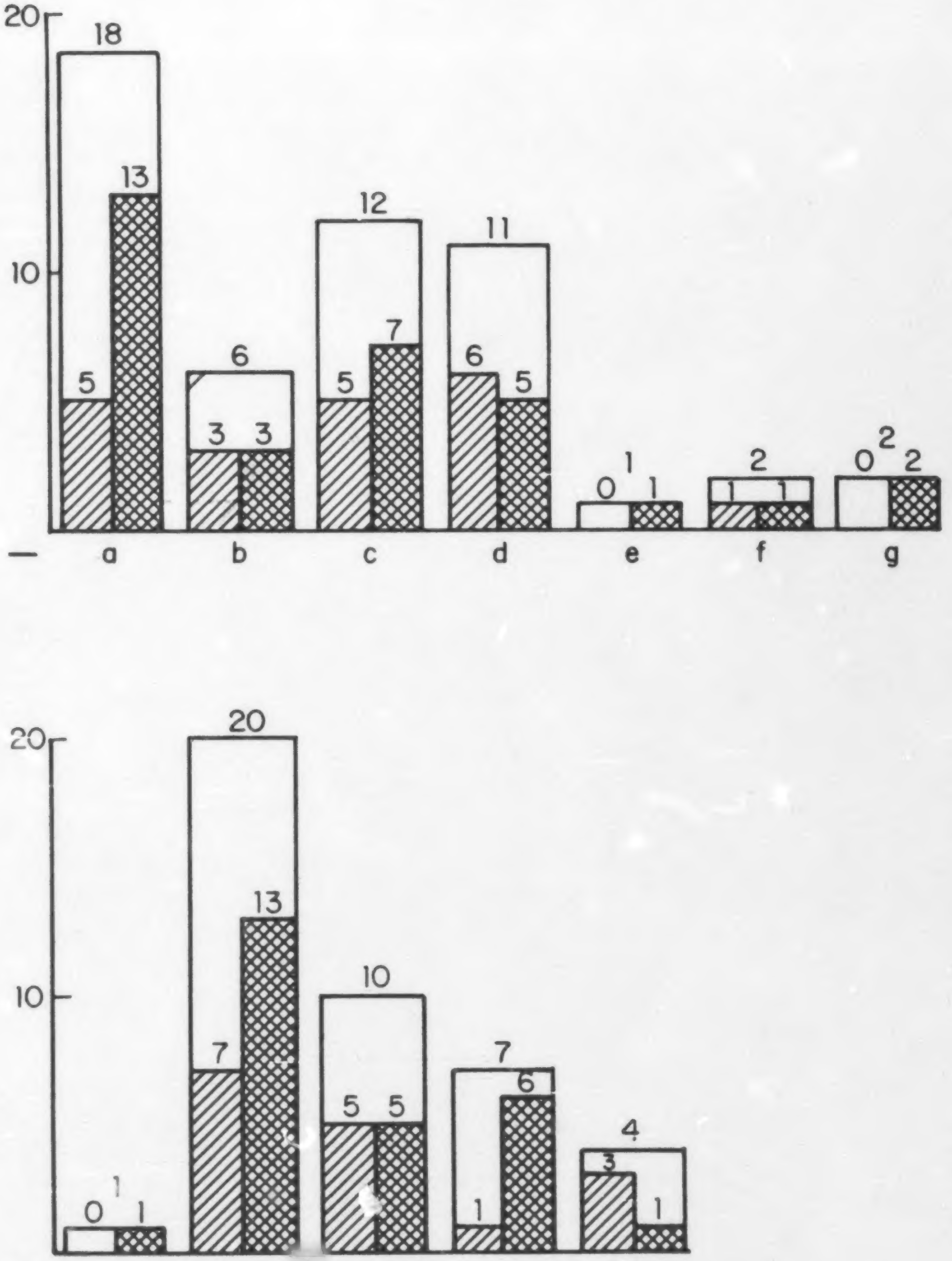

CHART 7 FACTORS INFLUENCING NEGATIVE REACTION TO COURSE

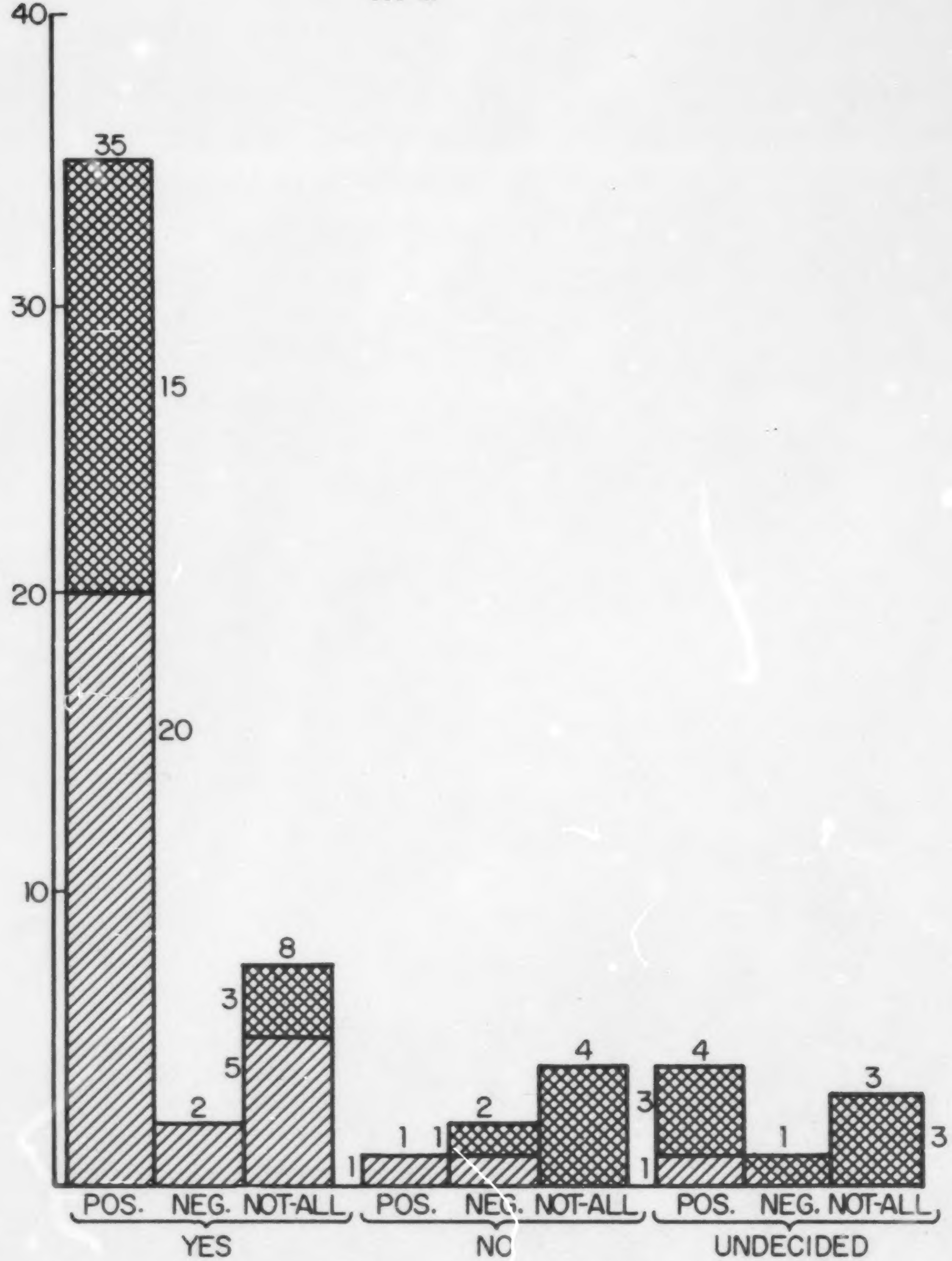

CHART 8 "TAKE COURSE AGAIN?" AS RELATED TO S&T OUTLOOK

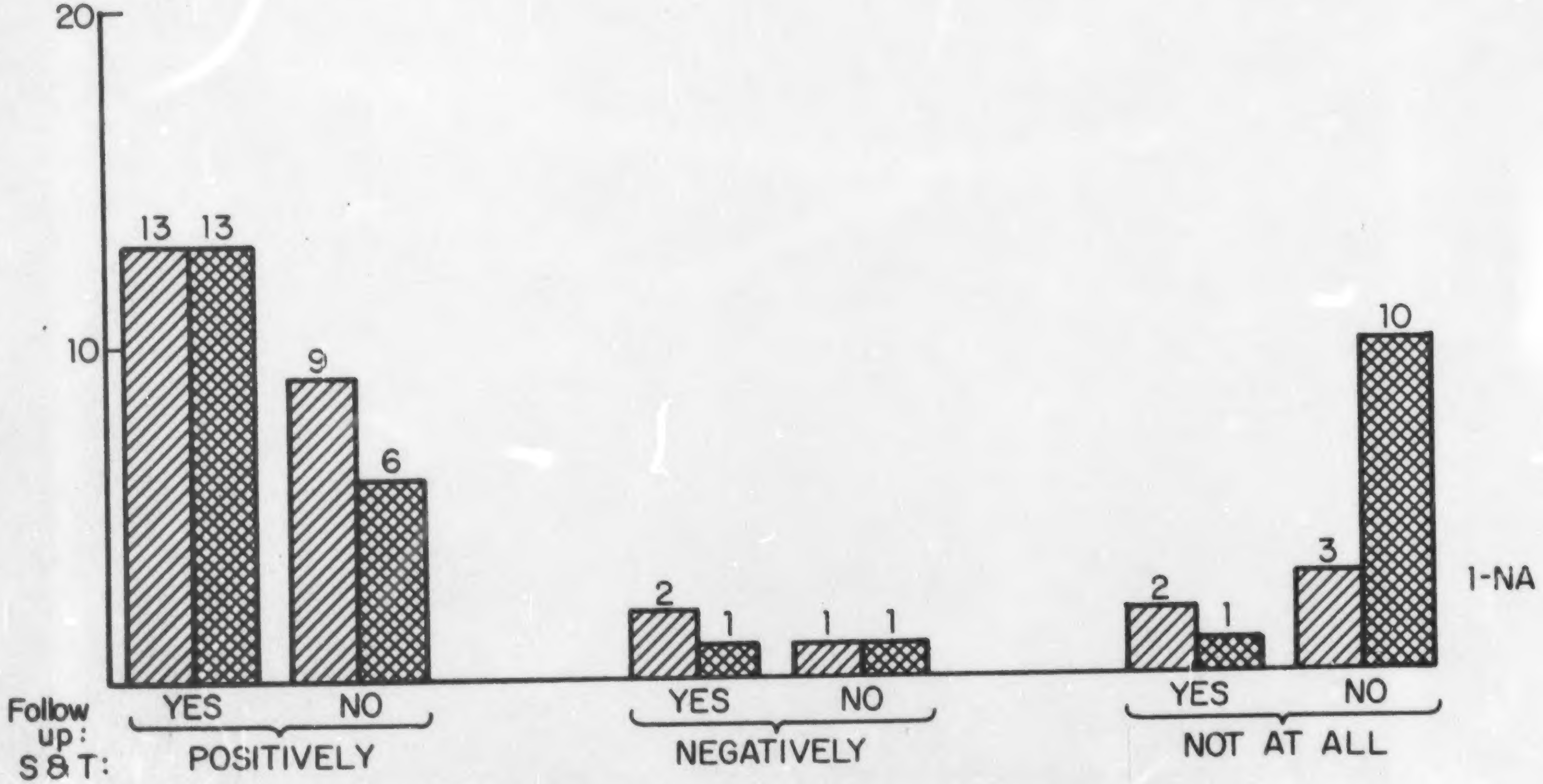

CHART 9 FOLLOW-UP ACTIVITY AS RELATED TO S & T ATTITUDES

		POS.	NEG.	NO	POS.	NEG.	NO	POS.	NEG.	NO	POS.	NEG.	NO	POS.	NEG.	NO	POS.	NEG.	NO	
A	Hi	4	–	1	–	–	–	–	1	–	2	–	–	1	–	–	7	1	1	(9)
	Lo	2	–	–	1	–	–	1	–	$\boxed{1}$	2	–	–	–	–	–	6	0	1	(7)
B	Hi	2	–	–	–	–	–	–	–	1	5	–	1	–	–	–	7	0	2	(9)
	Lo	1	–	$\boxed{1}$	1	–	–	–	–	–	3	1	$\boxed{2}$	–	–	–	5	1	3	(9)
C	Hi	–	–	–	–	1	–	–	–	–	1	–	1	–	–	–	1	1	1	(3)
	Lo	–	–	$\boxed{1}$	1	1	–	–	–	–	–	–	–	–	–	–	1	1	1	(3)
D	Hi	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0	0	(0)
	Lo	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0	0	(0)
E	Hi	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0	0	(0)
	Lo	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	1	0	0	(1)
P	Hi	2	–	–	1	–	–	1	1	–	3	–	1	–	–	–	7	0	2	(9)
	Lo	2	–	–	1	–	–	–	–	–	3	–	$\boxed{5}$	–	–	–	6	0	5	(11)
F	Hi	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0	0	(0)
	Lo	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0	0	(0)
Total	Hi	8	0	1	2	1	0	1	2	1	11	0	3	1	0	0				
	Lo	5	0	2	4	1	0	1	0	1	8	1	7	0	0	0				
		(13)	(0)	(3)	(6)	(2)	(0)	(2)	(2)	(2)	(19)	(1)	(10)	(1)	(0)	(0)				

CHART 10

Distribution of High-Low Interest by S & T Outlook, Grade, and Major

APPENDIX IV

An Empirical Analysis of Natural Sciences 130

II

Fall, 1971

William Schroeder

This paper is simply a sequel to "An Empirical Analysis of Natural Sciences 130" by N. Zapol (Appendix III). The first paper deals with the construction of a questionnaire addressed to the students of the named course in the Fall of 1970, and the analysis of the results of that questionnaire. A slightly augmented, but essentially similar probe was tried on the students of the same course when it was given in the Fall of 1971. This paper deals with the results of the second round, and draws some conclusions through comparison of the two.

Change in the Questionnaire

This writer has every sympathy with the reader who doubts the probity of making changes in a questionnaire at all when one is a) intending to make some kind of comparison, and b) not entirely certain just where the strengths and weaknesses of the original instrument lie. This observation leads to a classification of the additions and changes into three types:

1. Additions which reflect the changed nature of the course itself. At least one change, the inclusion of a required five-minute videotape, probably could not have been ignored without distorting the answers in the remainder of the questionnaire, and in general, additions of this type should not be passed over despite the difficulties that they create, for presumably their omission would create greater difficulties.

2. Additions which reflect feedback from the original questionnaire, or other feedback gained after the time that the original questionnaire was prepared. An example of this would

be Positive p. in question four "The staff argued in class". The only possible defense of such an addition is that having left it off in the first place was inexcusable in the face of the feedback which we received, and the issue was too important to ignore even with the risk of skewing the comparison. Nevertheless, the presence of such a new element must surely have affected the answers to the other questions, especially in view of the continuum fashion which the question was stated.

3. Questions which were added to sharpen the thesis of the original paper, for example, question 8; "How many pre-lecture sections did you attend?", combined with question 9 "Did you use Matthews at any other time than the pre lectures?". (These also fall into category 1...). One can only say in this case that one must be extremely circumspect in the way in which one applies the information gained from such questions.

In the case of this particular questionnaire, the aims of this paper can be aided by one simplifying assumption, which is that the student answers the questions sequentially; that is, the statement of previous questions may affect the way that the student answers a given question, but the reverse is not true. That is, a student will not go back to change the answers on previous questions based on the statement or the answer to a given question. (This hypothesis is also supported to an extent by the fact that there is no visible evidence of such changes in the form of erasures or crossings-out.) This assumption will be assumed to hold except within question 4, for the reasons stated above.

(The reader is directed to Attachment A, where the new questionnaire appears.)

Comparison of Response

Having concluded the preliminary footwork, the next step is a point by point comparison of the responses which Zapol considered critical to the thesis of her paper:

1. Size of response. Remarkably, we received the same number of filled-out, attributable (with names or otherwise identifiable) questionnaires (63) as Zapol, with a slightly smaller population (99). The distribution of this response over class, field, and grade (see chart in Attachment B) is perhaps even more uniform than Zapol's, though it shares some of the predictable lacunae (failures, etc.).

2. Validity of diary. Although many did not feel pressed to give any sort of answer to the questions on the second side at all, we can assume from responses to the first part of section 12 that at least 58 did look at the second side all the way through. 5 did not respond to the "work" question at all (Does the diary give an honest account of your work in the course?), over half, as last year, responded either "No", or "Sort of" (32), and 21 said "yes". This matches well with last year. The response on the "attitudes question" (Was the diary an honest reflection of your attitudes, feelings, reactions ...), however, was significantly different from Zapol's response. Of the 58 who we can be sure saw the question, only three did not respond at all. Only 4 answered

"No" to this question, only 13 answered "sort of", while 38, or about 70%, said "Yes", compared with 43% in Zapol's response. I would like to reserve comment on this until later in the paper except to say that I feel that the comparison is one of the ones which can legitimately be made, the wording in both versions being nearly identical, none of the added questions seeming to influence this response, and the diminution in total response simply the fault of the doubled length of the second instrument.

3. High and low interest. In Zapol's group, high interest meant those who checked either 1 or 2 in both parts of question 3. There were no others this year who checked 1 in the interest category, and in fact only a few who checked 2. For the benefit of those who like to make exceedingly fine points, those who checked 3, 2, or 4, 2 are grouped as "middle interest" in the chart in Attachment C. For the purpose of comparison, they should be grouped with Zapol's low interest students. (To quote Zapol: "this category merely reflects personal priorities." I would alter that to say that this category reflects the image of priorities that the student wishes to project. Thus the issue of questionnaire candour raises its ugly head again.)

As to the validity of high-low interest, Zapol found that it was not a factor in staff assessment of student work, in that it did not seem to correlate with the grade awarded to the student. Looking at the chart in Attachment B, the reader may wish to qualify that statement for this year's data slightly. Remaining with Zapol's analysis for a moment (lumping middle and low interest together), we still find a significant preponderance of high interest in the A's, and a great preponderance of low interest in those who chose pass-fail (even though all respondents passed). If, as this writer suggests, we take the work interest to mean solely that, and lump the "middle interest" with the high interest, a significant preponderance of high interest appears in the B's also (67%), although the dramatic figures in the "Pass" category flatten out a little.

Furthermore, close attention should be given to the C and D categories, in view of the manner in which grades are awarded at this level. All work at this level is regarded as substandard, and it is not really stretching appoint too much to interpret a C grade as the staff's evaluation of some "redeeming quality" of the students. In this regard, the figures, though scanty, are conclusive. All C's fall in the amended high interest category, all D's in low interest.

Zapol also attempted to differentiate between high and low interest in answers to question 1 and question 12. In question 1, preserving for a moment Zapol's criteria, there is virtually no difference between the response of high and low interest groups. In question 12 (If you had it to do all over again, would you take Nat. Sci. 130 over again?), 11 low interest were undecided or negative, while only one high interest was undecided and none were negative. The second finding is considerably more decisive than Zapol's finding of last year, giving additional support to the hypothesis that a literal interpretation of interest is the key factor that Zapol is looking for.*

---

*Inclusion of "middle interest" category with high interest does not materially alter these findings.

What can be said about the academic characteristics of each group? First, let us check out Zapol's findings. She found that Humanities concentrators and Social Sciences Pass-Fail contained a large preponderance of low-interest students. This year Humanities shows a 50-50 split (10-9) and Soc. Sci. Pass-Fail shows slightly less low interest than the overall for pass-fail (75% as against 83%), so we can thankfully dump such prejudicial findings, and refrain from introducing others, since the only category that might be mentioned is, in fact, the one called "Other". (The spread of "middle interest" is also fairly uniform.)

As regards the preference factors (Question 4), much of Zapol's analysis will not be considered for two reasons. First, because the added questions change the frame of reference drastically, and second, because the discussion is in no way weighted for relative numbers of high and low interest students responding. As far as I can see, some useful information of an heuristic nature can be inferred if we pursue the assumption that a near 2:1 preponderance in responses one way or another may indicate a difference in the way in which high and low interest students respond to the course (given that the groups were about equal in size). This produces four special groups of responses:

A. Positive responses which high interest students clearly prefer:

The content met your needs	15-8
The course challenged you	13-3
Your personal life was good	7-3
You wanted a chance to do independent reading	11-3
You needed this for a Nat. Sci. requirement	23-11
The staff argued in class	9-5

B. Positive responses which low interest students clearly prefer:

The course was experimental	12-20
You like not working for a grade	4-7

C. Negative responses which high interest students prefer:

You weren't interested in the content	5-2
The requirements were too hard	2-1
The staff intimidated you	4-2

D. Negative responses which low interest students prefer:

The requirements were too easy	1-3
There was too much freedom, not enough structure	3-6
The staff argued too much in class	3-6

Zapol's response included seven such "characteristic responses", this list totals 14. The only responses that repeat are negative. ("The requirements were too easy", and "There was too much freedom, not enough structure".)

Examination of Attachment C will show what the addition of the figures for the "middle interest group" to the high interest group does to the figures. The effect of this on the analysis of question four can be predicted immediately from a single characteristic of this group. The average number of positive checks per questionnaire was about 6 1/2. The nine members of the middle group produced exactly 57, right on average. The average number of negative checks was about 2 1/2, and this group produced an average of less than one. (High interest: about 2, and low interest: about 3 1/3.) If the data has any validity at all, this seems a clear mandate to separate the middle group from the lower group, and perhaps also a mandate to separate completely.

If we group high and middle interest, we have, instead of a nearly even split, almost a 2-1 split, so we would require something like a 3-1 ratio to indicate a high-middle interest preference, a 1:1 ratio or worse for a low interest preference. With this stipulation;

A. remains unchanged - all ratios increase dramatically

B. gains one: "The requirements were easy". This was not "characteristic" in Zapol's data.

C. all entries vanish, since the 2:1 ratio does not increase

D. gains five entries (see Attachment C)

The isolation of the middle group thus results in a net gain of three characteristic responses.

What, if anything, concrete can be said about this? All of the above taken together indicates that it is possible to isolate groups of students whose responses to question 4 are characteristically different. Since question four deals with some pretty concrete things, this opens the possibility of tailoring the course toward those groups of students, should the decision be made that that is a good thing to do. The lack of repeating characteristic responses from last year is indeed discouraging. One reason not to be deterred is that the conduct of the course was to some extent affected by the questionnaires and like data; the other reason will be confronted in the next section.

A Digression on the Subject of Student Candor

Before we pass on to the last and most important part of Zapol's analysis, that of students entirely unaffected by the course, some basic considerations should be faced. We are confronted with data which suggest serious disagreement with a number of Zapol's conclusions, but the axe cuts both ways. Sometimes this writer finds clarity where Zapol found none, and vice versa. At least two conclusions are open to us. We may decide that the attempt to make such measurements and judgments is truly a will-o'-the-wisp, even _a posteriori_. The problem with this conclusion is that nobody really wants to jump to it. All too many of Zapol's conclusions and those of this writer ring true to those who were involved in the process of teaching the course. There must be wheat among the chaff.

If there be wheat among the chaff, we should be able to do the following sorts of things:

1. We should be able to sharpen the instruments in order to produce more agreement between the two (and subsequent) years.
2. We should be able to uncover artifacts in the data to explain differences between the runs of the experiment which cannot be reconciled otherwise.

The fact that such an attempt flies in the face of numerous experiments with no-significant-difference outcomes should not discourage us; it should only make us the more meticulous. As far as (1) goes, this paper contains some justification for a refinement of the high-low interest categorization which seem to make it a better predictor of certain kinds of behavior. This is based on the slight evidence offerred that the staff can recognize a high interest student. Concerning (2) I would like to discuss a specific artifact and its relation to the other findings. Reference was made earlier to the response on the second part of question 6, concerning the validity of attitudes expressed in the diary. This question elicited the most startling difference between the two years, a much larger number declaring that, in fact, they had been candid about their attitudes, feelings, etc. Why should we assume that this is an artifact, and not just statistical scatter? I offer two reasons: First, the impressions of those reading the diaries indicate that there was a great deal more negative (albeit not always unconstructive) commentary in the diaries this year than last year. I find constructive criticism strong evidence of considered candor. In addition, the course was no longer a new one; there was no rosy glow of experiment to induce one to gloss over anything, no special reason to pretend interest and commitment. Second, the attitude of the staff toward the diaries was much more matter-of-fact and realistic; we may assume from this that the students could well have felt more free to express themselves. We also were now explicit about what the diaries were meant to be.

Accepting this first hypothesis of diary candor urges the assumption of candor in the questionnaires as well, since it seems safe to presume that the questionnaire calls forth responses which are formed while writing the diaries. Should this be in fact the case, it might explain both the disappearance of spurious results and the sharpening of others. Let us only state at this time, however, that it offers a possible interpretation for a number of divergences between the two sets of data which can probably be tested quite easily in the next round of the experiment.

No question on the questionnaire suggests itself as a possible cross-check for candor; however a very interesting one might be to have each section person rate his students as to interest categories, and to compare that with the output of the questionnaire. Since the accuracy of this prediction would be a nice thing to know in and of itself, it might be worth trying.

Students Unaffected By The Course

These are defined, by Zapol's criteria, as those who:
1. experienced no effect upon their outlook on science and technology, 2. did not mention any follow-up activity, and 3. would not take the course again. They are: T. C., R. E., P. N. F. Fortunately, the number is small enough so that I may justly refrain from generalizations. Instead, I would like to discuss one of the three, N. F., who happened to be in my section. N. had two earnest and interesting conferences with me on the subject of his project, which turned out to be a thoughtful and interesting analysis of some of the language used by Marshall MacLuhan in Understanding Media. He spoke up in class several times to some purpose, and did a most entertaining and interesting videotape involving a rather zany, but apparently honest experiment. His diary was fragmentary but not negligible. To say that N. was unaffected by the course implies either that we place a rather narrow interpretation on the word

(too narrow, I mean to say), or that we reject the value of the tried-and-true (sound papers and class discussion) and also our most promising innovation (the videotape).

We may say, however, that of the students who did do follow-up, high and middle outnumbered low by 31 to 12 (we would expect 2:1) and of the students who elected to take the course again, high and middle outnumbered low 36 to 10, and that the three infamous unaffected students all belonged to the low interest group.

Zapol's Conclusions

1. "A student might profit from the course just by 'being there'". This conclusion is not supported by the data this year (despite the terrific counterexample of N. F.). High interest students do more follow-up, and high interest students characteristically choose responses which indicate that they experienced more, liked it more, and accepted more challenges.

2. "... getting something from the course would demand either a commitment of time and interest or a desire to get into the science and technology aspects of it, or both." For the first part, *vide supra* my hesitant suggestion that time and interest should be separated, and that in fact interest is the more important indicator. An interesting artifact of the grading chart is that the middle interest group got the lowest percentage of A's and the highest percentage of B's, indicating that their lack of time commitment was real and hurt them when it came to the crunch. This is by way of saying that time and interest are both important, but that they should not be lumped together. I

feel that the isolation of science and technology as part of the course rather than as the general framework is not susceptible to any sort of analysis even as precise as the sorts carried on above.

3. "a total of all but ten people seemed to feel that the staff and the 'broad range of interesting topics' factored significantly in their interest in the course, a fact which throws some doubt on the "packagability" of the course ...". Zapol allows that the broad range of topics, attracting 67% of the respondents may not be dependent on the fine staff, whom this year 40% liked, 9% were intimidated by, while 14% felt that they argued too much. The topics, the videotape, and the other ideas are of course exportable - the larger and more diffuse the staff gets, the less it depends on any personality. The real question is, who would pay for it?

This Writer's Conclusions

1. Many of the results obtained in Zapol's paper disagree with results which appear in this year's data. This is to be expected in any endeavor dealing with such soft variables. However, we should have the courage to assume that some of the disagreements may be the reflections of real differences, while others may be resolved by a more sophisticated approach to the data.

2. The most significant single datum is the large number of students who feel that their diary responses were candid. This argues for preference of this year's questionnaire data over last year's, and it also urges those involved in giving the course to encourage this factor further. For example, early citation of both

positive and negative passages, and/or some discussion of the value that we place on candid data might help to increase this useful tendency.

3. The most important conclusion is tentative. It seems unassailable, as Zapol suggested, that the student's evaluation of his time and interest commitment can function as a predictor for several of the qualities and types of activity that the course esteems. These include:

a. Grades (performance)
b. Follow-up
c. Preferential attitudes toward different aspects of the course.

I do not suggest that we have in any sense a refined instrument. In particular, it is not clear that the "middle interest" group should be combined with the high interest group, although it seems clear that they do not belong with the low interest group. Nevertheless, I hope that I have been able to offer enough information in this paper to indicate that there is wheat among the chaff somewhere.

4. What might be done next year to refine this instrument further?

a. Since one of the ideas suggested by the data is that the staff can, to an extent, recognize a high-interest student, asking the staff to rate their students at the end of the course prior to the questionnaire (and perhaps at the beginning too)

b. In responding to question 4, if the students were asked to give a specific number of responses (say 7) to both the positive and negative parts of the question, characteristic responses should stand out more clearly. At the moment, high interest students litter on the positive side, low interest on the negative side, just because that's the way they feel.

c. Some more searching questions might be asked as to why question 3 is answered as it is, e.g., what courses interested you more and why? Also, we might simply ask the principal focus of their interest - since question 4 does not elicit this.

5. Why on earth should this be done? The assumption here is clearly twofold; first, we want to change the course in such a way that it produces high interest and commitment, and second, failing that, we want to change the course so that it will attract more high interest students and do more for them. Given these aims, the questionnaire becomes a probe for direct feedback on this question, largely through question 4, but also 7, 8, and 9. (More low-interest than high interest students used Matthews Basement, for example, and more attended pre-lecture sections. Figure that one out. From the response, it seems that the pre-lecture sections were a turn-off for a significant number of low-interest students, although not for high-interest.) Social psychology holds all too few variables which can be assigned by an observer in such a way that the assignee will agree with him a significant percentage of the time. Perhaps this is one.

ATTACHMENT A - Questionnaire 1971-72

Name ______________________________

1. Did Nat. Sci. 130 affect your outlook on science and technology? If so, how?

Positively	Negatively	Not at all
1	2	3

2. As a result of Nat. Sci. 130, are you planning to become involved in anything --- courses, projects, papers, future plans --- that you would probably not have considered otherwise?

Yes	No	If YES, explain briefly.
4	5	

3. Compared with your other courses last semester, Nat. Sci. 130 ranked (circle one for each, 1 = most, 4 (or 5) = least).

6 1   7 2   8 3   9 4 — (5)   in terms of time spent

[illegible] 1   11 2   12 3   13 4 — (5)   in terms of interest in the course

4. The following is a list of positive and negative factors we think might have affected your involvement in the course. If you can think of others, please add them. Then circle the items which applied to your case and check the single most important factor.

Positive

14 a. There was a broad range of interesting topics.
15 b. The content met your needs (personal; other courses; etc.)
16 c. The course challenged you.
17 d. The course introduced new ideas.
18 e. The course was experimental.
19 f. Your personal life was good.
20 g. You wanted a good grade and thought you could get it.
21 h. You like not working for a grade.
22 i. The requirements were easy.
23 j. You like writing diareis.
24 k. You liked your project.
25 l. You wanted a chance to do independent reading.
26 m. You liked the staff.
27 n. You needed this for a Nat. Sci. requirement.
28 o. You enjoyed using videotape.
29 p. The staff argued in class.
30 q. other
__ r.

Negative

31 a. The content was too superficial.
32 b. You weren't interested in the content.
33 c. The lecture format was too traditional.
34 d. Your personal life was bad.
35 e. You get anxious about grades.
36 f. You don't do much work for pass/fail courses.
37 g. The requirements were too easy.
38 h. The requirements were too hard.
39 i. Diaries are a pain.
40 j. Your project was an abortion.
41 k. There was too much freedom; not enough structure.
42 l. You didn't like the staff.
43 m. You needed this for a Nat. Sci. requirement.
44 n. The videotape project was a pain.
45 o. The staff argued too much in class.
46 p. The staff intimidated you.
47 q. other
__ r.

TURN PAGE OVER.

5. Did you:
   a. Read in preparation for a few [] 48 many [] 49 no[] 50 lectures? Yes[] 51 No[] 52
   b. Do outside activities related to the course? Yes[] No[]
   If so, what? 53 54

   c. Do additional reading? Yes[] No[]
   If so, in what areas? 55 56

6. a. Does your diary refle~~ct~~ ~~th~~e above acitvities? Yes[] 57 No[] 58 Sort of[] 59
   b. Was your diary an honest reflection of your attitudes, feelings, reactions, etc. toward the course? Yes[] No[] Sort of[]
   If NO or SORT OF, any comments? 60 61 62

7. a. Do you think your section assignment worked well for you? yes 63 no 64 maybe 65

   b. Did you make use of the other staff members? yes 66 no 67 maybe 68

8. How many pre-lecture sessions did you attend? 69 0 70 1-3 71 4-7 72 8+
   Did you find them interesting[] 73 useful[] 74 boring[] 75 ?

9. Did you use Matthews at any other time than the pre-lectures? Yes[] 76 No[] 77
   If so, what for?

10. If you chose to take the course Pass/Fail, had you already completed your Nat. Sci. requirement? Yes[] 78 No[] 79

    If you chose to be graded, was your main consideration the fullfillment of the Nat. Sci requirement? Yes[] 80 No[] 81
    If NO, explain.

11. If you were graded, did you get what you expected?
    Yes[] 82 No[] 83 Lower[] 84 Higher[] 85

12. If you had it to do over, would you take Nat. Sci. 130?
    Yes[] 86 No[] 87 Undecided[] 88

    Would you take Nat. Sci. 130 if it were not a Gen. Ed. requirement?
    Yes[] 89 No[] 90 Undecided[] 91

sex 92: + female - male
questionnaire 93: + yes - no
P/F 94: + yes - no

grade [illegible]: A B C D
95 96 97 98

Major nat sci 100
soc sci 101
hum 102
other 103
[illegible] 104 105 106 107

ATTACHMENT B-DISTRIBUTION OF RESPONSES

LEGEND

Course total

high →
mid. →
low →

	Freshmen		Hum.		Nat. Sci.		Soc. Sci.		Other		Total		
A	1	1 0 0	4	2 0 2	0	0 0 0	9	6 1 2	0	0 0 0	14	9 1 4	ALL A's RESPONDED
B	12	5 3 3	12	7 0 3	0	0 0 0	13	3 2 3	2	0 0 1	39	15 5 10	30/39 RESPONSE
C	3	0 1 0	2	0 0 0	1	1 0 0	1	1 0 0	2	1 0 0	9	3 1 0	4/9 RESPONSE
D	1	0 0 0	3	0 0 0	0	0 0 0	4	0 0 2	1	0 0 0	9	0 0 2	2/9 RESPONSE
Inc. →	1		1	0 0 1	0		0		0		2	0 0 1	1/2 RESPONSE
P (NO FAILS RESPONDED),	0		8	1 0 3	3	0 1 1	9	1 1 2	2	0 0 2	22	2 2 8	12/22 RESPONSE
TOTALS		6 4 3		10 0 9		1 1 1		11 4 9		1 0 3		29 9 25	

ATTACHMENT C

Questionnaire Tally

CODE	TOTAL	31 HIGH	9 MIDDLE	23 LOW
1. + on 1	37	18	6	13
2. - on 1	8	2	0	3
3. Not at all on 1	19	9	3	6
No answer 1	4	2	0	1
4. Yes on 2	43	24	7	12
5. No on 2	20	7	2	11
No answer	-			
6. Time 1	14			
7. Time 2	22			
8. Time 3	15			
9. Time 4, 5	11			
10. Int. 1	11			
11. Int. 2	26			
12. Int. 3	11			
13. Int. 4, 5	11			
No answer	3			
14. Interesting topics	44 (5)	20	8	16
15. Content met needs	23 (2)	15	2	6
16. Challenge	15 (2)	12	0	3
17. New ideas	43 (5)	22	8	13
18. Experimental	32 (3)	12	6	14
19. Personal life good	10 (0)	7	1	2
20. Good grade wanted	6 (0)	3	1	2
21. Liked not working	11 (0)	4	1	6
22. Requirements easy	11 (0)	5	1	5

CODE		TOTAL	31 HIGH	9 MIDDLE	23 LOW
23.	Like writing diaries	7 (1)	4	1	2
24.	Liked project	42 (4)	22	8	12
25.	Chance to do independent reading	14 (0)	11	1	2
26.	Liked staff	26 (0)	15	3	8
27.	Nat. Sci. requirement	34 (1)	23	4	7
28.	Enjoyed videotape	49 (11)	25	9	15
29.	Staff argued	14 (0)	9	3	2
30.	Other	9 (1)			
31.	Content superficial	24 (6)	12	2	10
32.	Not interested	7 (0)	5	0	2
33.	Lectures traditional	11 (2)	6	0	5
34.	Personal life bad	8 (2)	3	0	5
35.	Anxious about grades	2 (0)	1	0	1
36.	Don't work for p-f	1 (1)	0	1	
37.	Too easy	4 (0)	1	0	3
38.	Too hard	3 (0)	2	0	1
39.	Diaries are a pain	19 (1)	9	4	6
40.	Project aborted	5 (0)	2	0	3
41.	Too much freedom	9 (0)	3	0	6
42.	Didn't like staff	4 (0)	2	0	2
43.	Needed for Nat. Sci.	7 (4)	3	0	4
44.	Videotape a pain	6 (1)	3	0	3
45.	Staff argued too much	9 (2)	3	1	5
46.	Staff intimidated you	6 (2)	4	0	2
47.	Other	22 (7)			
48.	A few on 5	52			
49.		0			

CODE	TOTAL	31 HIGH	9 MIDDLE	23 LOW
50.	5			
51.	44			
52.	5			
53.	28			
54.	17			
no answer	18			
55.	36			
56.	21			
57. Diary activities yes	21	10	3	9
58. no	10	4	2	4
59. sort of	22	14	1	7
60. Diary attitudes yes	38	15	6	17
61. no	4	3	0	1
62. sort of	13	8	2	3
63.	31			
64.	20			
65.	8			
66.	35			
67.	11			
68.	10			
69.	15			
70.	21			
71.	16			
72.	5			
73.	24			
74.	7			
75.	13			

	CODE	TOTAL	31 HIGH	9 MIDDLE	23 LOW
76.	Used Matthews yes	43			
77.	no "	18			
78.	P-F Nat Sci req't yes	8			
79.	no "	1			
80.	Graded Nat Sci req't yes	32			
81.		16			
82.		21			
83.		17			
84.		11			
85.		7			
86.	Take 130 again yes	46	27	9	10
87.	no "	6	0	0	6
88.	? "	6	1	0	5
89.	Take 130 if not req't yes	45	20	7	18
90.	no "	10	3	0	7
91.	? "	12	6	2	4

92.	♀	q.	♂	♀	non q.	♂	♀	total	♂
	15		48	6		28	21		76
93.		62			35				
94.	p-f	12			10			22	
95.	A	14			0			14	
96.	B	30			8			38	
97.	C	4			5			9	
98.	D	2			7			9	
99.	E	0			4			4	

	q	non q	total
100. Nat. Sci.	3	1	4
101. Soc. Sci.	32	14	46
102. Hum.	24	14	38
103. Other	2	2	4
104. Fresh.	13	4	17
105. Soph.	16	6	22
106. Jr.	16	7	23
107. Sr.	16	15	31
108. Other	2	2	4

APPENDIX V

AN EMPIRICAL ANALYSIS
OF
NATURAL SCIENCES 130
III

Fall, 1972

Nikki Zapol

This analysis of Nat. Sci. 130, 1972-73, concentrates on results of this year's questionnaire. Comparisons with the previous two years are made in the body of this report.

I. Questionnaire Form

The same questionnaire was used this year as last (Attachment A). A few questions (numbers 8 and 9) did not pertain to the course this year. Some questionnaires had already been sent out when this was realized; a surprising number of those who received these uncorrected forms actually responded to the questions, expecially that concerning pre-lectures, as if they were expected to have known these things existed. True, movies were often shown before class, and this might have been interpreted as "pre-lectures", but what about "If Matthew is the person who was there, he put my videotape on my section man's master tape." in response to the Matthews Basement question?

II. Size of Response

53 people responded out of 80 taking the course and these were quite evenly distributed over grade, class and major, with somewhat of an over representation of Seniors and pass-fail students. (See Attachments A and B).

III. High and Low Interest

Let us reconsider the meaning of this category. The original categorization was devised as a method of getting at the question "who got involved in (the course) and why?" (Zapol, Appendix III p.17). Time and interest assessments on the part of each student seemed a logical way of finding out who really was involved. Since that time, Schroeder has raised the issue of whether the method of sorting these categories was correct (IV-15). The original division was:

High Interest

a. All those who checked either 1 or 2 for both time and interest (question #3).
b. Those who checked 1 for interest and anything else for time.

Low Interest

a. Those who checked below 2 for either, with the exception of (b) above

Schroeder was concerned with those who circled two for interest and below two for time. This year there were six people who checked 3 time, 2 interest. Are these a different group, or do they belong with the high interest, or the low interest? We might remember that what we are concerned with is involvement, not interest. In some nontrivial ways, it is certainly possible to be very interested but not very involved, because, typically, one has other time pressures that prevent any serious encounter with that subject. Just being interested is not enough then, it is also important to arrange ones scheduling pressures to allow a deeper commitment. The original division of high and low interest categories was meant to reflect this discrepancy.

If interest and involvement could be distinguished with our categories we would expect some characteristic differences between those for whom the course was high in terms of interest and time and those for whom it was high only for interest. (For example, the one person, D.F., who checked 1 for interest and below 2 for time was in my section. He seemed to be interested in the lectures, although I don't believe he ever participated in class discussions, and did not seem to get involved with anything in particular, including videotapes. His project was a very small extension of his own very engrossing hobby and I was quite certain that it did not take much effort for him to turn it out. In a word, I did not feel he got very involved with the course. He received a C+.)

The rest of this year's data suggest, however, that this middle group is in fact more like the high interest group in terms of grades and responses to the course as determined in question 4, than like the low interest group.

Using Schroeder's method of comparing average number of checks on the positive and negative parts of question 4, we find

1. On the positive checks:
    - Overall average: 5 1/2
    - High: 6 1/2
    - Med: 8
    - Low: 4 1/2.
2. On the negative checks:
    - Overall: 2 1/2
    - High: 1 1/2
    - Med: 2
    - Low: 3

These data could suggest, as Schroeder suggested his data could (IV-8), that the middle interest group is a distinct unit. The middle group's larger number of positive checks could also lend support to Schroeder's thesis (IV-13) that "their lack of time commitment was real and hurt them when it came to the crunch." But his evidence for this statement was a higher percentage of B's than in the high interest or low interest groups, a situation that does not exist this year. The safest conclusion would appear to be that we cannot hope to make fine distinctions with such a crude instrument and that the best we can do is amend the categories as follows:

High interest - those who check 1 or 2 for interest and anything for time

Low interest: everyone else

It should be noted that in all three years, only one person checked 1 for interest and 4 for time.

Returning now to the data, we did find that there were 14 high interest, 6 middle and 30 low, or, in terms of the amended categories: 20 high and 30 low, a ratio of 2:3. There is a generally even distribution of high and low interest among grades and majors, although freshmen have a notably higher ratio (5:3) of high interest than other groups (5/8 of the Freshmen were high interest), and pass-fails more low interest (1:6).

How can we characterize these two groups?

First, let us look at the preference factors in question 4. As was shown above, the low interest people checked, on the average, a significantly larger number of negative factors (3) and a smaller number of positive factors (4 1/2), than did the high interest people, who checked an average of 1.7 negative factors, 6.8 positive. In what factors does the difference show up?

Given the 2:3 high:low interest split, we could look for a 1:2 split in the total number of checks a factor received from the high and low interest groups, respectively, if we are to roughly estimate a low interest weighting; 1:1 to favor high interest.

A. Positive responses which high interest students clearly prefer:

There was a broad range of interesting topics	15-15
The content met your needs	7-5
The course challenged you	8-4
The course was experimental	11-10
Your personal life was good	5-3
You wanted a good grade and thought you could get it	5-0
The requirements were easy	6-5
You like writing diaries	6-0
You wanted a chance to do independent reading	5-3
You liked the staff	12-6

B. Positive responses which low interest students prefer:

You like not working for a grade	2-5

C. Negative responses which high interest students prefer:

Your personal life was bad	5-5
You get anxious about grades	2-2
Your project was an abortion	4-4
The videotape project was a pain	2-1

D. Negative responses which low interest students prefer:

The content was too superficial	2-12
You weren't interested in the content	0-7
You don't do much work for pass/fail courses	0-2
The requirements were too easy	0-4
Diaries are a pain	7-14
There was too much freedom; not enough structure	1-7
You needed this for a Nat Sci requirement	3-9
The staff argued too much in class	1-3
The staff intimidated you	1-3

This supports Schroeder's thesis that "it is possible to isolate groups of students whose responses to question 4 are characteristically different." High interest students were satisfied with what the course offered and the way it was conducted. Low interest students weren't. Whether high interest encourages satisfaction with the course or vice versa is a causality problem which cannot be determined from the data. We do believe, however, that the generally even distribution of high and low interest over grades (see Attachment B) indicates that these categories are not ex post facto assigned by the student on the basis of the grade he received. Instead, the high-low interest designation would appear to be a measure of student involvement which provides us with a rather steady gauge for determining the impact of the course.

IV. On Honesty

The data suggest that we should believe what we've got as evidence, both the diaries and the questionnaires. On question 6, only 3 people felt their diaries did not represent their attitudes towards the course. Many felt it "sort of" did ("My feelings were slightly less positive than my diary reflected"; "When I started I didn't know what to put in a diary. It wasn't until about 1/2 way through that I began to write honestly".) The answers to this question indicate that many people took this question to be asking whether they were keeping a true stream-of-consciousness on-the-spot account, to which the honest answer is, at best, sort of.

That the purpose of the diary was not really clear is evident in the number of "no" responses (14) to the activities portion of this question. This would indicate that we should be more specific in our instructions next year. I see no reason, however, to doubt the veracity of the questionnaire responses (the high number of low interest people would seem sufficient evidence here) and I concur with Schroeder's hunch that there were many negative comments in the diaries, due at least in part to the feeling that there was "no special reason to pretend interest and commitment."

Schroeder suggested that we check this honesty estimate by asking each section person to rate time and interest for his section. We did that this year and the results are:

Staff Guessed:	Interest	Time	Total
higher than students	22	15	37
lower	12	18	30
same	13	16	29

The staff did not do well in matching the exact student assessment; was it more successful in the more general estimate of high and low interest (e.g., student says 1 for interest, the staff member 2: these are both in our high interest category)? Staff guesses were no better within these broader parameters: staff guessed 10 out of 19 high interest people correctly; 13 out of 28 low interest people correctly.

There are several ways of interpreting these figures. If we follow Schroeder's implication that the staff estimate might be a check to see whether the students were telling the truth or feigning higher interest and time than they really devoted to the course, then it looks like a good portion of the students succeeded in fooling us, that we estimated approximately 1/2 to be higher on interest, 1/3 higher in time. But then, of course, we are admitting that the student was telling the truth on the questionnaire, indicating that he certainly didn't intend to fool us in the first place. One could contort these interpretations many ways: e.g., lower staff guesses indicate the student is lying on the questionnaire, etc. But the best case seems the most obvious of all: the staff has a close to even chance of guessing higher, lower, or on target, and that is simply saying that the staff doesn't really know what is going on in such delicate matters. The staff isn't therefore much of a check on honesty although it might be worth taking note if in future years we find some unusual lacunae in this relatively even distribution.

The Low Interest Phenomenon

Because there were so many more low interest people this year than the past two, it is interesting to try to find some characteristics of this group. 25 of the 30 answered "undecided" or "no" to one or both of the two parts of question 11: If you had it to do over, would you take Nat Sci 130 and Would you take Nat Sci 130 if it were not a Gen Ed requirement? Of the high interest people, 6 out of 20 fell in this category. As an ex post facto, this comes as no surprise. What is perhaps more interesting is that only one high and one low checked no for both parts of the question.

The rest were "yes" or "undecided" on taking it again and "undecided" or "no" on taking it again if it weren't a requirement. Which suggests, perhaps, that using the course as a Nat Sci bypass is likely to produce a less than optimal encounter with the course, although the chances of being high interest were equally poor for those taking the course pass-fail: 1 was high interest, 6 low. This suggests an interesting conclusion, discussed in greater detail in our comparison of the three years, that both those trying to fulfill the Nat Sci requirement and those taking it ungraded are now apt to be using the course to minimal advantage: as a requirement bypass or a chance to relax from the tension of more demanding courses. If taking it graded, but not primarily to fullfill the requirement, the odds are better than 2:1 of falling in the high interest category. Simply put, the highest odds of becoming involved with the course were if the student was taking it because he really wanted to, not if he had to, and then felt bound to stick to it, probably because he would be graded.

Grading

Very few people got the grade they expected. Only 6, in fact. Of the remainder, 25 (9 high interest, 13 low) got lower than they expected; 11 (4 high interest, 7 low) received higher grades than expected.

Did the staff know this? If we group the staff's estimate of high and low interest of the entire class and look at this in terms of grades given, we get the following picture:

		High Interest Staff Estimate	Low Interest Staff Estimate
Grade	A	10	1
	B	18	5
	C	6	20
	D	1	5

The correlation between estimated involvement and grade given would seem quite high. High interest estimates had a 4:1 chance of getting a B or an A. Low interest, a 5:1 chance of getting a C or D. High and low interest as estimated by staff, then, is not nearly as randomly distributed over grades as it is based on self-assessment (see Attachment B). The question arises of whether the staff felt it was rewarding high involvement, when in fact this is something it could not judge. It is more likely, however, that the staff tended to reason from high quality work to high involvement. In the cases where the staff knew this was not so (where quality came with little sweat), quality won out. Conversely, there were a number of pluggers who the staff knew worked extremely hard on the course but had little to show for it. Quality won out here, too, much to the dismay of a few of our students.

Then, too, there is the possibility that while the staff felt a B was a grade of reward, the students didn't. Of our questionnaire respondents, the B's divided: 5 got what they expected; 7 lower, 4 higher. Of the 7 lower, 4 were high interest. 1 high interest felt the grade was higher, 3 got the B they expected. So, the B is certainly not a grade for which one is always thankful, or putting it another way, the staff's threshold level of reward was higher than what the students expected.

Those Unaffected by the Course

Schroeder argues that this is something we cannot find by juggling questionnaire categories. I am inclined to agree, to a certain extent. Perhaps the point is that, although we cannot say for sure that these people are totally unaffected (the word is, after all, very broad) by the course, the encounter was far from optimal, and that it might be interesting to find out why. The problem lies in the crudity of using the questionnaire for finding the answer. Some facts derivable from the questionnaire this year are:

1. There were six in this category comprised of those who: (a) experienced no effect upon their outlook on science and technology (Appendix III, Attach. A, #3); (b) did not mention any follow-up activity (same, #5) and (c) would not take the course again or were undecided (same, #87, 88, 90, 91). Four felt that the content was too superficial (same, #31), or that they weren't interested in the content (same, #32) or both. These responses were characteristic of the low interest group (19 of 30 checked #31, 32 or both as opposed to 2 of the 20 highs), but seemed to be even more powerful factors here. One student circled the "not interested" factor, adding "This was my main problem. I just plain was not interested in the course, and not motivated enough to bother to unravel its confusion."

2. All were low interest; of the 5 that were graded (1 A, 1 B, 1 B-, 1 C, 2 C-), all were taking it for a Nat Sci requirement.

3. The first two criteria: no effect on science and technology outlook, and no follow-up were really the determining factors for this category. All who circled these two factors would not take the course again, save one person, N.B., (A Soc Sci senior) who was undecided.

4. The staff placed 4 of the 6 in the low interest group, so has a higher batting average here.

5. There were 4 seniors (all social relations) and two freshmen.

Conclusions

1. the amended high-low interest category seems useful in sorting out characteristic responses to the course. To repeat what Schroeder said, "high interest students characteristically choose responses which indicate that they experienced more, liked it more, and accepted more challenges." If anything, this was more true this year than last, although the grade distribution reflects it less.

2. There were many students who really did not get involved with the course. They appeared to want more structure, more digestible content, more guidance. The category of those least affected by the course, a subset of this low interest group, points to Soc Sci seniors using the course as a Nat Sci bypass as being a particularly uninspired group.

3. The staff, while on target in its feeling that there was a good deal of frustration with the course (see preference factors, p. 4-5), was not able to guess the high-low interest ratings with better than random accuracy. Perhaps, guessing on the basis of the project,

diary, and videotape, they may have been asking themselves "how hard would I have to work, how interested would I have to be to produce this result?" In other words, they might be using themselves as a yardstick and work backwards, from the grade to the assessment. The student, of course, works forward. Whatever the grade, the involvement is a thing of the past and remains so. While there may have been a few cases where knowing how hard a student worked had an influence on assigning a grade, these were kept to a minimum, as reflected in vigorous discussions during the grading session. In general, the staff tended to reason from high quality to high involvement, rather than vice versa. Even if it had good cause to believe otherwise, the staff used quality as the determining factor.

4. Exactly what "getting something from the course" (Zapol, Appendix III, p. 26) would demand is not clear. While high interest appears to guarantee "getting something" (according to our definition any one or more of the following: outlook on science and technology affected, follow-up planned, would take course again), low interest does not guarantee not getting anything. Why some low interest people are more stimulated and satisfied by the course than others cannot be determined from available data.

5. Many people did not record course-related activities in their diaries. Clearer instructions might be warranted.

ATTACHMENT A

Questionnaire Tally

() = no high/low interest designation

Code	Total	31 High	9 Middle	23 Low	
1. + on 1	29	8	5	15	(1)
2. - on 1	3	1	1	0	
3. Not at all on 1	15	3	0	12	
No answer 1	2			1	(1)
(+ and -, + and NA) - and NA)	4	2	0	2	
4. Yes on 2	28	9	4	13	(2)
5. No on 2	23	4	2	17	
No answer	2			1	(1)
6. Time 1	6				
7. Time 2	13				
8. Time 3	20				
9. Time 4, 5	11				
NA	3				
10. Int. 1	7				
11. IInt. 2	13				
12. Int. 3	11				
13. Int. 4, 5	18				
No answer	3				
14. Interesting topics	38	10	5	15	(3)
15. Content met needs	14	5	2	5	(2)
16. Challenge	12	8	1	3	
17. New ideas	35	9	5	19	(2)
18. Experimental	22	7	4	10	(1)

Code	Total	31 High	9 Middle	23 Low	
19. Personal life good	10	6	0	3	(1)
20. Good grade wanted	5	4	1	0	
21. Liked not working	7	1	1	5	
22. Requirements easy	11	3	3	5	
23. Like writing articles	6	4	2	0	
24. Liked project	33	9	4	18	(2)
25. Chance 4 independent reading	8	2	3	3	
26. Liked staff	21	8	4	6	(3)
27. Nat Sci requirement	25	5	5	14	(1)
28. Enjoyed videotape	39	10	5	21	(3)
29. Staff argued	9	3	1	5	
30. Other	9	3	2	3	(1)
31. Content superficial	15	2	0	12	(1)
32. Not interested	8	0	0	7	(1)
33. Lectures trad.	5	0	2	3	
34. Personal life bad	10	3	2	5	
35. Anxious about grades	5	2	0	2	(1)
36. Don't work for p-f	2	0	0	2	
37. Too easy	4	0	0	4	
38. Too hard	0	0	0	0	
39. Diaries are a pain	24	4	3	14	(3)
40. Project aborted	8	2	2	4	
41. Too much freedom	8	0	1	7	
42. Didn't like staff	3	0	0	2	(1)

Code	Total	31 High	9 Middle	23 Low	
43. Needed for Nat Sci	12	3	0	9	
44. Videotape a pain	3	2	0	1	
45. Staff argued too much	4	0	1	3	
46. Staff intimidated you	4	1	0	3	
47. Other	18	2	2	11	(3)
48. A few on 5	45	7	5	28	(3)
49.	6	4	1	1	
50. No	2	1	0	1	
51 Yes	20	5	2	11	(2)
52. No	0	0	0	0	
53. Outside act. - yes	25	10	3	11	(1)
54. No	20	4	1	15	
no answer	0	0	0	0	
55. Add. reading - yes	31	12	5	11	(3)
56. No	20	2	1	17	
57. Diary activities yes	14	5	0	9	
58. no	14	3	2	8	(1)
59. sort of	19	5	4	8	(2)
60. Diary attitudes yes	28	8	4	16	
61. no	3	0	0	3	
62. sort of	21	6	2	10	(3)
63. Section assignment yes	29	9	2	16	(2)
64. no	10	4	1	4	(1)
65. maybe	7	0	2	5	
other	6	1	1	4	

Code		Total	31 High	9 Middle	23 Low	
66.	staff - yes	24	7	3	11	(3)
67.	no	20	4	3	13	
68.	maybe	8	3	0	5	
69.		8	4	0	4	
70.		3	1	1	1	
71.		0	0	0	0	
72.		0	0	0	0	
73.		3	1	1	1	
74.		0	0	0	0	
75.		2	1	0	1	
76.	Used Matthews yes	1	1	0	0	
77.	no	8	1	0	7	
78.	P-F Nat Sci req't yes	6	0	0	6	
79.	no	1	0	1	0	
80.	Graded Nat Sci req't yes	35	9	4	20	(2)
81.	no	10	6	1	3	
	both	2	0	0	1	(1)
82.	Grade expected yes	6	3	2	1	
83.	no	17	5	1	10	(1)
84.	lower	25	8	1	13	(3)
85.	higher	11	2	2	7	
	?	3	1	0	2	
86.	Take 130 again yes	30	11	6	12	(1)
87.	no	9	1	0	8	
88.	?	13	2	0	9	(2)
89.	Take 130 if not req't yes	21	10	6	3	(2)

Code		Total	31 High	9 Middle	23 Low	
90.	no	16	2	0	14	
91.	?	12	2	0	9	(1)

94.	p-f	7	1	8
95.	A	7	5	12
96.	B	20	7	27
97.	C	17	10	27
98.	D	2	3	5
99.	E	0	0	0
	Inc	0	1	

		q	non q	total
100.	Nat. Sci.	3	1	4
101.	Soc. Sci.	20	11	31
102.	Hum.	18	8	26
103.	Other	2	1	3

104.	Fresh.	10	6	16
105.	Soph.	8	6	14
106.	Jr.	13	7	20
107.	Sr.	21	7	28
108.	Other	1	1	2
		53	27	80

ATTACHMENT B-DISTRIBUTION OF RESPONSES

LEGEND

Course total ↓ (boxed, upper left of each cell); high →, mid. →, low → (right-hand column of each cell)

( ) = No high/low interest designation

	Freshmen			Hum.			Nat. Sci.			Soc. Sci.			Other			Total			
A	2	1	0 0 1	6	4	1 1 2	1	0	0 0 0	3	2	2 0 0	0	0	0 0 0	12	7	3 1 3	7/12 RESPONSE
B	7	4	2 1 1	8	7	1 1 4 (1)	1	1	0 0 1	10	7	2 0 5	1	1	1 0 0	27	20	6 2 11 (1)	20/27 RESPONSE
C	7	5	1 1 1 (2)	8	5	1 0 4	0	0	0 0 0	10	6	1 1 4	2	1	1 0 0	27	17	4 2 9 (2)	17/27 RESPONSE
D	0	0	0 0 0	2	2	1 0 1	0	0	0 0 0	3	0	0 0 0	0	0	0 0 0	5	2	1 0 1	2/5 RESPONSE
Inc. →	0	0	0 0 0	1	0	0 0 0	0	0	0 0 0	0	0	0 0 0	0	0	0 0 0	1	0	0 0 0	0/1 RESPONSE
P	0	0	0 0 0	1	0	0 0 0	2	2	0 0 2	5	5	0 1 4	0	0	0 0 0	8	7	0 1 6	7/8 RESPONSE
TOTALS	16	10	3 2 3	26	18	4 2 11	4	3	0 0 3	31	20	5 2 13	3	2	2 0 0	80	53	14 6 30 (3)	53/80 RESPONSE

APPENDIX VI

Comparative Performance Analyses

APPENDIX VI-A

1971, 1972 Confidential Guide to Harvard: A Review of Courses*

Published by

The Harvard Crimson

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*The 1972 text is identical with the 1971 text. The review of 1972-73 performance will appear in the fall of 1973.

derstanding Indo-Pakistani culture. Several Indian novels dot the reading list.

The main lecturer is Revelle, a tall, soft-talking man who combines an informative, fact-filled lecture style with a pleasant sense of humor. The lectures are valuable to an understanding of the course, the delivery is good, if sometimes boring, and his organization is usually flawless.

Revelle is an eternal optimist as he discusses the deteriorating environment, cigarette in hand. He dismisses the end-of-the-world population alarmists for their lack of expertise and he gives compelling reasons why he does.

The reading list is excellent and is mostly comprised of current articles with some background. Paul Ehrlich's *Population and Resources* is well-written and covers the course material in a general way, though from his own point of view, of course. It's good to read at the end of the course. The reading list is well-organized, but a little long. It was constructed so as to give reading with varied points of view on each issue. There was some repetitive and some unnecessary reading.

The course meets three times a week, usually in three lectures. There is a section to replace a lecture every two or three weeks. The sections had little value to a central understanding of the course and were usually poorly attended and poorly prepared. Sometimes there was good discussion, but not often.

There is an hourly and a final. They are fairly graded by the sectionmen as a group and have occasional comments. The grading in the course eased up some last year, and most found themselves with honor grades.

Any student with a doomsday inclination will enjoy Nat Sci 118. It teaches you the mess man is making of the earth in a stimulating if not depressing manner. Roger Revelle is a friendly and sympathetic professor who has a good practical background to draw from. Nat Sci 118 is an easy and pleasant and relevant way to fulfill your Nat Sci requirement.

Nat Sci 130

Nat Sci 130 is one of those courses that for the first few sessions looks so good, that you can't believe it's not going to be one of the best courses you'll ever take and probably even a turning point in your life. But, somehow, by the end of the year half the class thought it had been a great—if not total—waste.

The topic of the course is "Communication in Societies," admittedly a rather large topic for one semester consisting of 24 class sessions but not surprising compared to other courses in the Harvard curriculum. Communications is undoubtedly a very interesting topic, one currently very fashionable and like other interesting and fashionable topics it is fairly well neglected by the Harvard faculty. The course is roughly divided into three broad areas: communications in man, communications in animals, and communications in machines. The breadth of the topic begins to become clear when you realize this takes in everything from linguistics to cybernetics to theatre to how the Mandarin Duck makes love. (This you can see in graphic living-color film.)

One of the most common complaints made was that the scope of the course was too large. Most people had the feeling that they were getting at best a very superficial review of a vast field. This was all the more frustrating because so many of the areas touched upon seemed so interesting.

And then there were those that were not so interesting. For me about half the areas seemed interesting. There was a dichotomy between those areas of a basically scientific nature and those of a basically humanistic nature. This dichotomy was reflected in the composition of the class: some people were in it as scientists interested in studying the scientific aspects of communications, and others were humanities people interested in the topic itself or in a humanistic way around their Nat Sci requirement. The course tried to follow a middle route, half the lectures being science oriented, half humanities oriented. As a result, half the class was bored most of the time.

The course has an unusually large staff including six teaching assistants and two extremely fine profesors, William H. Bossert and Anthony G. Oettinger, both McKay professors of Applied Math. Both are funny, exuberant, friendly, and profoundly interested in getting the students to enjoy what they're trying to teach them. The TA's range from fair to excellent and all have a certain degree of expertise in their own fields of interest.

The requirements are, to say the least, lenient. There are no exams of any kind, no sections, and no required papers. The only thing a student must do is submit a diary of what he has done in the course (including outside work relevant in any way) and of his reactions to the course, and also do some kind of project on anything in the area of communications. The project can be a paper, a film or a slide show, a demonstration, a computer program, or anything that any member of the staff will approve as a legitimate project.

Marking was in general very lenient—a B was given if any effort was shown.

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APPENDIX VI-B

Statistical Analysis by the
Harvard College Office of Tests

1970-1971

1971-1972

VI-B-1

THE AIKEN COMPUTATION LABORATORY
DIVISION OF ENGINEERING AND APPLIED PHYSICS
HARVARD UNIVERSITY, CAMBRIDGE, MASSACHUSETTS 02138

8 February 1971

Dr. Dean Whitla
Office of Tests
University Hall 11
Harvard University

Dear Dean,

Here is the material I have mentioned to you several times and with which I would very much like to have your help! If any of this is too much work, what I want unclear, a significant analysis impossible or impractical, or if you want more data, please holler! I should be very grateful if, in every case where you come to some conclusion, you can give me some back-up by way of a brief discussion of whatever tests you applied in a way that would satisfy your fellow statisticians.

With respect to the row totals of Table 1, I'd be interested in knowing whether the distribution by classes is

A. a sample of the college class distribution or skewed in some way, and

B. a sample of the distribution of classes in other Nat. Sci. 100 level courses or else skewed in some noticeable way.

The same questions regarding Table 1 apply with respect to the column totals as far as distribution over the three major areas of concentration is concerned.

With respect to Table 2, is this a reflection of the normal college rank order of concentration? of the normal Nat. Sci. 100 level course rank order of concentration?

What I'm after in all these questions regarding Tables 1 and 2 is whether or not I have in any way drawn an unusual clientele or an ordinary sample of the college.

Enclosure 2 is a class list with the students marked by various concentration and enclosure 3 is the same class list with final grades. The class list should enable you to look up the PRL's* at least for the undergraduates. (Forget the graduate students.)

* PRL = Predicted Rank List, a measure of expected college performance based on secondary school grades, CEEB tests, etc.

A. Do I have a normal PRL distribution for the whole class? or have I got a significant deviation up or down?

B. Are the PRL's typical within the three areas of concentration? or again is there some deviation.

C. How do our grades correlate with PRL's? do our grades generally agree with these predictions? differ significantly? I am particularly interested as far as the Freshmen are concerned since we seem to have given them an unusual number of A's (see Table 4).

If you could look at all our A's and relate them to school background categories, this might be very interesting. Class disucssion about the course suggested to us that people from progressive schools and interestingly enough, people who had left the college for a year and returned liked the course a lot better than the others. I'd be interested to know if there is any correlation with performance.

Again, with respect to Table 4, we seem to have given an unusually high number of A's to Freshmen and a rather low number to Humanities people. How deviant are we?

Finally, with respect to Table 6, I'm interested in some clue regarding who came to the course in the first place and who stayed. We seem to have lost more sophomores and seniors than freshmen and juniors and I'm not sure whether those numbers mean much, and if they do, how to explain them. As far as table 6B goes, we seem to have scared people away impartially as far as upper classmen are concerned. The attrition seems about the same in all three major areas of concentration. Does that hold up? This puzzles me somewhat since we scared away no more humanists than nat. sci. types and yet the humanists performance seems (significantly?) poorer than that in either of the other two areas and particularly than the freshmen.

If the foregoing is too much to wack off at once, I'd be grateful for your dribbling results back to me as soon as you can get some. I'd also appreciate your calling to my attention any questions that I should have asked or that pop up at you from looking at this data.

Your help in this is warmly appreciated! If there is some way I can return the favor, as for example, by taking measurements of interest to you on the class next year, I'd be very happy to reciprocate.

Sincerely yours,

Tony

Anthony G. Oettinger

AGO:chm
cc: Nat. Sci. 130
NSF/Tact book

P.S. I forgot to talk about Table 5. I'd be interested in knowing whether the relative proportions of pass/fail and graded students is normal or deviant.

A. G. Oettinger

AGO:chm

	HUM	SOC.SCI.	NAT.SCI.	OTHER	
FR					23
SO	3	11	4	2	20
JR	10	21	2	1	34
SR	7	11	5	1	24
OTHER				2	2
	20	43	11	6	103
	63		11		

Table 1. Class Distribution by Area of Concentration

SOC.REL.	12	LINGUISTICS	4	ECONOMICS	2
GOV'T.	12	APP. MATH	4	ANTHRO.	1
ENGLISH	8	FINE ARTS	3	ASTRON.	1
HISTORY	6	VIS. STUD	3	BIO.	1
SOC.STUD	5	MATH.	3	CHEM.	1
PSYCH.	5	MUSIC	2	PHYS.	1
					74

Table 2. Class Composition by Field of Concentration
(Upper Classmen only)

	FR	HUM	SS	NS	OTHER		
P	7	6	20	4		37	38 Pass/Fail
F					1	1	
A	7	2	6	4	2	21	65 Graded
B	8	5	15	1	1	30	
C	1	4	1	1	1	8	
D		1				1	
E		2	1	1	1	5	
	23	20	43	11	6	103	
	23	63		11	6		

Table 3. Class Grades Distribution

	%A's	%F's
F	50	0
HUM	14	14
SS	26	4
NS	60	14
CLASS	32	9

Table 4. A's and F's (among those who elected grades)

	FRESH.	HUM.	SOC.SCI.	NAT.SCI.	CLASS
P/F	30	30	46	36	38
GRADE	70	70	54	64	62

Table 5. Percent Electing Pass/Fail and Grade

	#		%		
	Before	After	Before	After	$\frac{\text{After}}{\text{Before}} \times 100$
FR	32	23	21.3	23.7	72
SO	32	18	21.3	18.6	56
JR	37	33	24.8	34	89
SR	49	23	32.6	23.7	47
	150	97			

6 a

	#		%		
	Before	After	Before	After	$\frac{\text{After}}{\text{Before}} \times 100$
FR	32	23	21.3	23.7	72
HUM	33	20	22.1	20.7	61
SOC.SCI.	67	43	44.6	44.2	64
NAT.SCI.	18	11	12.0	11.4	61
	150	97			

6 b

Class-wide $\frac{\text{after}}{\text{before}} \times 100 = 65$

Table 6. Distribution of Students Who Signed Up At Initial Sessions and of Those Who Remained in the Course.

VI-B-7

HARVARD COLLEGE

THE OFFICE OF TESTS
Dean K. Whitla, Director

II UNIVERSITY HALL
CAMBRIDGE, MASSACHUSETTS 02138

June 8, 1971

Professor Anthony G. Oettinger
Aiken Computation Lab. 200

Dear Prof. Oettinger,

With genuine apologies for the tardiness of this letter, let me begin finally to answer some of your questions regarding Natural Sciences 130.

I. Class Distribution

With approximately 33% juniors in Nat. Sci. 130, your class distribution is clearly skewed in favor of juniors and away from sophomores. However, since Nat. Sci. 130 is a middle level General Education course, the amount of skew is not terribly out of order. The table below gives the percent class distribution of Nat. Sci. 130 and all other middle group Nat. Sci.'s.

	Natural Sciences 130	Other Natural Sciences
Freshman	22.8%	23.6%
Sophomore	19.8%	29.2%
Junior	33.6%	24.2%
Senior	23.8%	23.0%

On first glance at the above, juniors and sophomores appear to be out of line by a considerable margin. However, it is doubtful that this is in any way significant especially since the distribution for seniors and freshmen in your course is comparable to other Natural Science middle group courses. Further, it is quite conceivable that a fair amount of the skew is due to the fact that yours is a new course offering. If you wish, I shall be happy to pursue the question further.

II. Concentration Distribution

On the next page is a table showing the percent distribution of concentrations in Nat. Sci. 130, other middle group Nat. Sci.'s, and the College in general.

Concentration	Natural Sciences 130	Other Natural Sciences	College
Natural Sciences	14.9%	17.3%	23.9%
Social Sciences	58.1%	64.6%	52.3%
Humanities	27.0%	17.3%	23.8%

While there is indeed some variation between Nat. Sci. 130 and the other two categories, it is extremely doubtful that the variation is at all significant. In addition, much of the variance between Nat. Sci. 130 and the College is explained by the Nat. Sci. by-pass in the General Education Program.

With some minor exceptions (economics, biology, and math), the general order of fields of concentration shown in your Table II is just about on the money. To give you some background for comparison, I have enclosed a copy of the distribution among fields of concentration for the Classes of '69 and '70. Certainly there appears to be nothing so grossly out of line in the distribution to warrant any particular attention.

If I may comment for a moment on the student sample in Nat. Sci. 130, it would appear to be fairly representative of the College. On the matching criteria used, there is nothing to indicate that the students in your course are markedly different from the general population of students in the College and from students in other middle group Natural Sciences in particular. As you have already observed, the students in the course lean toward the humanities and tend to be a bit older but not enough to cast serious doubt on the validity of the sample.

III. Predicted Rank List

The average P.R.L. for the 53 students in Nat. Sci. 130 for whom I could find a P.R.L. was 3.3. The average P.R.L. for incoming students is about 3.5. The .2 difference between the two averages is insignificant. Looking at the averages within areas of concentration, however, provides a bit more food for thought. I was able to obtain both P.R.L. and concentration information on only 38 students (average P.R.L. for the 38 students was 3.0). The distribution of these students compared to graduates of the Classes of '69 and '70 is broken down on the next page.

	Average P.R.L.	
Concentration	Natural Sciences 130	Classes of 1969-1970
Natural Sciences	2.5	3.2
Social Sciences	3.0	3.7
Humanities	3.3	3.6

This distribution begins to explain, in some part, the poorer performance in the course which you noted in the humanities concentrators. Once again, because of small numbers and generous variances, the statistical tests are not conclusive.

The correlation of P.R.L. with grades is not particularly good in Natural Sciences 130. The r is .140 in your course. To give you a benchmark, the coefficient of correlation between the P.R.L. and the overall grade average in the College runs between .560 and .620. Obviously, there is tremendous variation in the coefficient on a course to course basis. To better demonstrate the range of variation between grades and P.R.L. I have enclosed a scatter plot.

IV. School Background

I took a look at the A's awarded to Harvard students to see how they related to the high school background. The data are confusing and inconclusive to say the least. Of the twelve men for whom I could find suffieient information, seven went to public schools and five to private schools (about the same breakdown as public/private schools in the College generally). Interestingly, Massachusetts and Texas accounted for seven of the 12 A's but I seriously doubt the significance or meaning of this little fact. In short, the data on school background is too skimpy to be able to make a great deal of sense. Perhaps after Nat. Sci. 130 is given next year, more can be said on the basis of pooling the students from both years.

V. Pass-Fail

Natural Sciences 130 had 37 students enrolled on a pass-fail basis (36.6%). Based on figures from 1969-1970, this would seem to be high. Last year the average pass-fail enrollment in Harvard courses was 21.6% and in the middle group Natural Science General Education courses it was only 10.0%. There has been a noticeable trend toward increased use of pass-fail this year so I would like to wait until figures are in from the Registrar's Office to draw any conclusions for the present academic year.

VI. Attrition

You have requested a comparison of attrition in Natural Sciences 130 during the "shopping period" at the beginning of the term versus attrition in other courses during this same time. I have searched high and low and have not been able to come up with any study on the subject. While everyone thinks that the two weeks of "shopping" serve a useful purpose, nobody has bothered to do any research on the topic. The questions you have raised are provocative and would seem to point out an area of practive which deserves some closer scrutiny.

In reviewing the above information, please remember that all observations are based on Harvard students only. It appears that at least until the formal nuptials take place the Office of Tests will be a little in the dark about the bride's vital statistics. Finally, we discussed over the phone the Course Grading Index. We shall be preparing the document over the summer and should have it ready in late September or early October. It contains a great deal of information which you should find of interest; I shall make certain that a copy of the printout for Nat. Sci. 130 is sent to you as soon as it is ready.

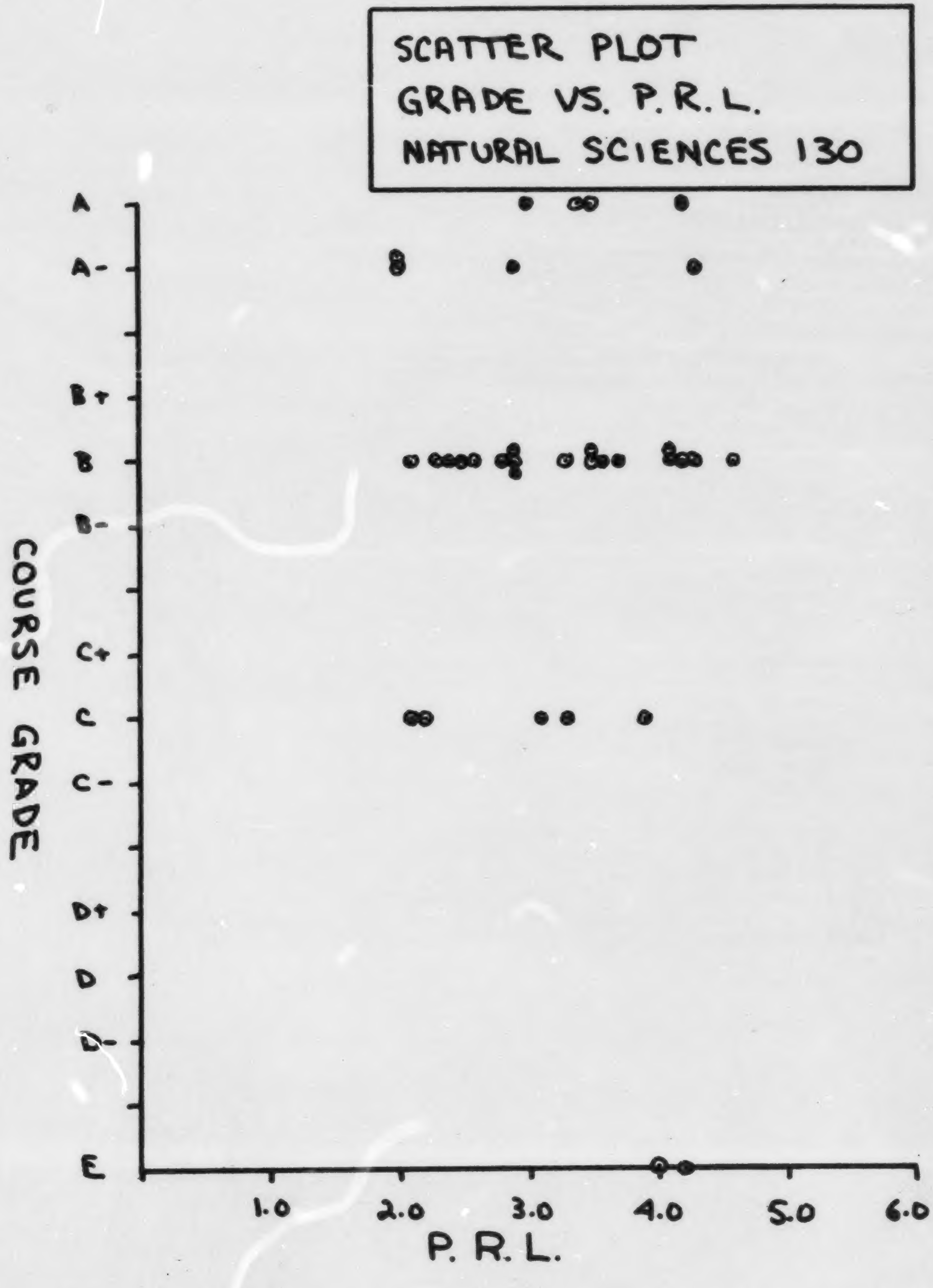
Once again, please accept my apologies for what must have seemed to you like an active attempt to withhold information from you. I assure you that such was not the case. I hope you find the information I have been able to compile of interest. If you wish additional information or further breakdowns please feel free to call me. I can promise you that future requests for data will be handled with considerably greater dispatch.

With kind regards,

Sincerely,

Lawrence F. Stevens

Lawrence F. Stevens
Research Assistant


SCATTER PLOT
GRADE VS. P.R.L.
NATURAL SCIENCES 130
A
A-
B+
B
B-
C+
C
C-
D+
D
D-
E
COURSE GRADE
1.0
2.0
3.0
4.0
5.0
6.0
P. R. L.

VI-B-12

HARVARD COLLEGE

THE OFFICE OF TESTS
Dean K. Whitla, Director

11 UNIVERSITY HALL
CAMBRIDGE, MASSACHUSETTS 02138

x 5-1580

12 November 1971

Prof. Anthony Oettinger
Computation Lab. 200
33 Oxford St.

Dear Prof. Oettinger,

Last spring I put together some figures for you concerning Nat Sci. 130. At the time I told you that during the fall the Office of Tests would perform the Course Grading Analysis on Nat. Sci. 130 and that I would forward a copy of the results to you. The enclosed sheet is the analysis I spoke of.

The course grading index is computed by comparing an individual student's grade in Nat. Sci 130 to his average grade in all other courses. The average of these differences for all students in the course is the course grading index. If the index is positive (as it is in the case of N.S. 130) it indicates that on the average the grade a student earned in N.S. 130 is higher than the average grade he received in his other courses. In addition to computing a total index, the analysis also computes the index within various subcategories such as year in school, concentration, and school affiliation. Thus, the 17 freshmen who took N.S. 130 received a grade which was (on the average) 2.6 points higher than the average grade received in their other courses. You should note that the index is computed for the students who took your course for a grade and excludes pass-fail students except in the two right hand columns. The only information given for pass-fail students is the number of students taking the course pass-fail (in the case of N.S. 130 this was 36) and the average of their graded courses (in the case of N.S. 130 this was 11.6 or somewhere between a B and B+).

I suspect that any further attempt at explanation of the numbers will only further muddy the waters. Perhaps the easiest thing is to have you take a look at the results and then, if you have any questions, you can give me a ring at 5-1538. I hope you find the analysis informative and interesting.

Regards,

Lawrence F. Stevens

Lawrence F. Stevens

LFS/a

```
NATURAL SCIENCES 130        TERM-FALL,1970-1971
                             COURSE     COURSE
                             GRADE    GRADE INDEX         T
                             INDEX     STANDARD
                                      DEVIATION

TOTAL                        0.811        3.225         0.251

AREA OF CONCENTRATION
    NATURAL SCIENCES         2.487        2.933         0.848
    SOCIAL SSCIENCES         0.443        2.939         0.151
    HUMANITIES              -0.813        2.559        -0.318
    NONE SPECIFIED           7.185*       2.185*        3.288*

CLASS STANDING
    FRESHMAN                 2.622        3.412         0.768
    SOPHOMORE                1.401        3.286         0.426
    JUNIOR                  -0.628        2.622        -0.240
    SENIOR                  -0.605*       1.761*       -0.344*
    S.B.(4TH+5TH YEAR)       0.0  *       0.0  *        0.0  *

AFFILIATION
    HARVARD                  0.596        3.072         0.194
    GRADUATE (A+S)           0.0  *       0.0  *        0.0  *
    GRADUATE (OTHER)         1.500*       1.500*        1.000*
    RADCLIFFE                1.467        3.810         0.385

* LESS THAN 10 STUDENTS
                                                8        7          
  15       14       12       11       10  GRADE DISTRIBUTION       6
   A       A-       B+       B        B-       C+       C        C-
    9      13       0        29       0        0        6        0

# OF STUDENTS REGISTERED HERE TAKING ONLY P-F COURSES WAS   0

STUDENTS NOT REGISTERED INITIALLY FOR PASS-FAIL -     0
    NAT.SCI.-    0      SOC.SCI.-     0     HUM.-    0     N.S.-
    FRESH.-    0     SOPH.-    0      JUN.-    0     SEN.-    0
    HARV.-     0     GRAD.(A&S)-    0     GRAD.(OTHER)-    0
```

```
 NUMBER      COURSE    COURSE R-THIS COURSE       NUMBER OF        AVERAGE
   OF        GRADE      GRADE   GRADE AND         STUDENTS          GRADE
STUDENTS     MEAN     STANDARD OTHER COURSE      (# IN DEPT)        P - F
(# IN DEPT)           DEVIATION  AVERAGE          P           F    MEAN  SD

  57 (  0)    11.9       2.34      0.02       36(   0)   0(  0)  11.6  2.1

  10 (  0)    12.5       2.33      0.16        5(   0)   0(  0)  12.2  1.1
  31 (  0)    12.0       2.14      0.04       23(   0)   0(  0)  11.7  2.1
  12 (  0)    10.8       2.61      0.35        7(   0)   0(  0)  11.4  2.5
   2*(  0)    13.0*      2.00*    -1.00*       1(   0)   0(  0)   8.8  0.0

  17 (  0)    12.5       2.30      0.02        6(   0)   0(  0)  10.3  2.1
  11 (  0)    12.1       2.23      0.06        4(   0)   0(  0)  10.3  3.0
  19 (  0)    11.3       2.36      0.18       13(   0)   0(  0)  12.4  1.6
   8*(  0)    11.6*      2.23*     0.62*      13(   0)   0(  0)  11.8  1.8
   0*(  0)     0.0*      0.0 *     0.0 *       0(   0)   0(  0)   0.0  0.0

  43 (  0)    11.6       2.28      0.08       21(   0)   0(  0)  11.3  2.4
   0*(  0)     0.0*      0.0 *     0.0 *       0(   0)   0(  0)   0.0  0.0
   2*(  0)    12.5*      1.50*     0.0 *       0(   0)   0(  0)   0.0  0.0
  12 (  0)    12.9       2.33     -0.24       15(   0)   0(  0)  12.0  1.6


     4          3          2         0
     D+         D          D-        E          P          F
      0          0          0         0         36          0


  0
   5TH YR.-      0      N.S.-      0
 RAD.-      0      N.S.-      0
```

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NATURAL SCIENCES 130                  TERM-FALL,1971-1972
                                       COURSE     COURSE
                                        GRADE   GRADE INDEX          T
                                        INDEX     STANDARD
                                                  DEVIATION

TOTAL                                  -1.270       3.459        -0.367

AREA OF CONCENTRATION
     NATURAL SCIENCES                   0.600*      2.400*        0.250*
     SOCIAL  SCIENCES                  -1.427       3.579        -0.399
     HUMANITIES                        -1.108       3.458        -0.320
     NONE SPECIFIED                    -2.873*      3.135*       -0.917*

CLASS STANDING
     FRESHMAN                          -1.726       3.176        -0.544
     SOPHOMORE                         -1.194       3.176        -0.376
     JUNIOR                            -0.858       3.818        -0.225
     SENIOR                            -1.435       3.832        -0.374
     S.B.(4TH+5T H YEAR)                0.0  *      0.0  *        0.0  *

AFFILIATION
     HARVARD                           -1.235       3.780        -0.327
     GRADUATE (A+S)                     0.0  *      0.0  *        0.0  *
     GRADUATE (OTHER)                   0.0  *      0.0  *        0.0  *
     RADCLIFFE                         -1.610       2.524        -0.638

* LESS THAN 10 STUDENTS

                                                  GRADE DISTRIBUTION
     A         A-         B+         B          B-        C+        C         C-
     6         8          13         17         9         2         4         2

# OF STUDENTS REGISTERED HERE TAKING ONLY P-F COURSES WAS    0

STUDENTS NOT REGISTERED INITIALLY FOR PASS-FAIL -     0
     NAT.SCI.-     0      SOC.SCI.-     0      HUM.-     0      N.S.-
     FRESH.-     0     SOPH.-     0     JUN.-     0     SEN.-     0
     HARV.-     0     GRAD.(A&S)-     0     GRAD.(OTHER)-     0
```

BEST COPY AVAILABLE

```
  NUMBER     COURSE    COURSE <--THIS COURSE      NUMBER OF        AVERAGE
    OF       GRADE     GRADE   GRADE AND          STUDENTS          GRADE
 STUDENTS    MEAN    STANDARD OTHER COURSE      (# IN DEPT)         P - F
(# IN DEPT)          DEVIATION  AVERAGE            P         F    MEAN  SD

  70 (  0)    10.1      3.81      0.42       20(   0)   0(  0)  11.7  1.6


   2*(  0)    10.0*     4.00*     1.00*       3(   0)   0(  0)  12.4  0.5
  40 (  0)    10.1      3.63      0.30       10(   0)   0(  0)  11.8  1.5
  22 (  0)    10.1      4.09      0.55        7(   0)   0(  0)  11.3  1.9
   3*(  0)     8.3*     4.50*     1.00*       0(   0)   0(  0)   0.0  0.0


  18 (  0)     9.4      3.43      0.39        0(   0)   0(  0)   0.0  0.0
  16 (  0)    11.1      3.04      0.04        2(   0)   0(  0)  10.4  0.4
  15 (  0)    10.3      4.30      0.46        6(   0)   0(  0)  12.0  1.7
  18 (  0)     9.5      4.27      0.46       12(   0)   0(  0)  11.8  1.6
   0*(  0)     0.0*     0.0 *     0.0 *       0(   0)   0(  0)   0.0  0.0


  51 (  0)     9.8      4.01      0.38       17(   0)   0(  0)  11.8  1.6
   0*(  0)     0.0*     0.0 *     0.0 *       0(   0)   0(  0)   0.0  0.0
   3*(  0)    11.7*     1.70*     1.00*       0(   0)   0(  0)   0.0  0.0
  18 (  0)    10.9      2.93      0.51        3(   0)   0(  0)  10.9  1.5



       D+          D          D-          E          P          F
        2          0           5          2          20         0



 0
   5TH YR.-       0       N.S.-       0
GRAD.-     0       N.S.-      0
```

VI-B-17

THE AIKEN COMPUTATION LABORATORY
DIVISION OF ENGINEERING AND APPLIED PHYSICS
HARVARD UNIVERSITY, CAMBRIDGE, MASSACHUSETTS 02138

7 March 1973

Dr. Dean Whitla
11 University Hall

Dear Dean,

I've now had a chance to compare the course grade index of Nat. Sci. 130 for 1971-72 (which you've just sent me) with the 1970-71 version.

The most striking observation is that the course grade index went sharply negative in 1971-72 from a positive value in 1970-71.

As the same time, your Pearson product moment measure of correlation for this course grade and other course average which was uniformly low in 1970-71 rose in 1971-72 but not spectacularly from .02 to .42.

The trend in the course grade index suggests that we might have graded more harshly but since, at the same time, the correlation with other course grade rose we might have attracted less able students. One way of helping me sort this out that occurs to me is to compare, once again, our grades with the predicted rank list for the students in the class.

To that end, I have enclosed a copy of Larry Stevens' letter of June 8, 1971 and call to your attention III on pages 2 and 3 of his letter and the scatter plot appended at the end of the letter. I have also enclosed a copy of the grade list for 1971-72.

I should be most grateful if you could develop for me the average P.R.L. for the 1971-72 Nat. Sci. 130 students and compare it with that of incoming students and also develop the scatter plot for 1971-72.

Since the comparison of P.R.L. and concentration was difficult and not particularly conclusive, I see no point in trying that again.

However, I should be most grateful if you could have someone hunt up data for the average P.R.L. and the scatter plot and get it back to me in short order. Many thanks!

Sincerely yours,

Anthony G. Oettinger

AGO:cmb
enclosures

VI-B-18

HARVARD COLLEGE

THE OFFICE OF TESTS
Dean K. Whitla, Director

11 UNIVERSITY HALL
CAMBRIDGE, MASSACHUSETTS 02138

23 March 1973

Professor Anthony G. Oettinger
Aiken 200

Dear Professor Oettinger,

This is in response to the questions you posed to Dean Whitla in your letter of March 7th.

On the whole, the changes in the C.G.I. and the correlation with other course grades for Nat. Sci. 130 seem to be the result of changes in the pattern of awarding grades.

In 70-71, the C.G.I. was 0.811; in 71-72 it was -1.270, a change of 2.081. In 70-71, the mean grade was 11.9; in 71-72 it was 10.1, a change of 1.8. Thus somewhat harsher grading accounts for 86% of the decrease in C.G.I. The small remaining decrease in C.G.I. is doubtless related to the general inflation in grades awarded in courses throughout the College.

The marked increase in the correlation with other course grades is probably due to a similar factor. In 1970-71, over half of the letter grades awarded were B's, and only four of the twelve possible levels of grades were in fact used. Since this pattern is quite different from that of grades in general, it is hardly surprising that the correlation was low. In 71-72, grades were distributed more widely and evenly, making possible a positive correlation with other course grades.

There has been a change in student talent. According to Larry's figures, the mean P.R.L. was 3.3 in 70-71. In 71-72, the mean P.R.L. for 43 students receiving letter grades for whom P.R.L.'s could be found was 3.8. By way of comparison, the mean P.R.L. for all undergraduates in 71-72 was 3.6. This decrease in mean P.R.L. of 0.5 is significant though not huge, being about half of the standard deviation. It suggests that the lower grades awarded in 71-72 were not solely due to harsher standards

Attached is scattergram of grade and P.R.L. for each of these 43 students. It can be seen that there is some positive correlation, unlike the previous year, but it is rather weak.

It is interesting that in 71-72 (unlike 70-71) there was no relation between grade received and area of concentration; the mean grade for Humanities concentrators was exactly equal to that for the course as a whole.

I hope this answer your questions. If not, please let me know.

Sincerely,

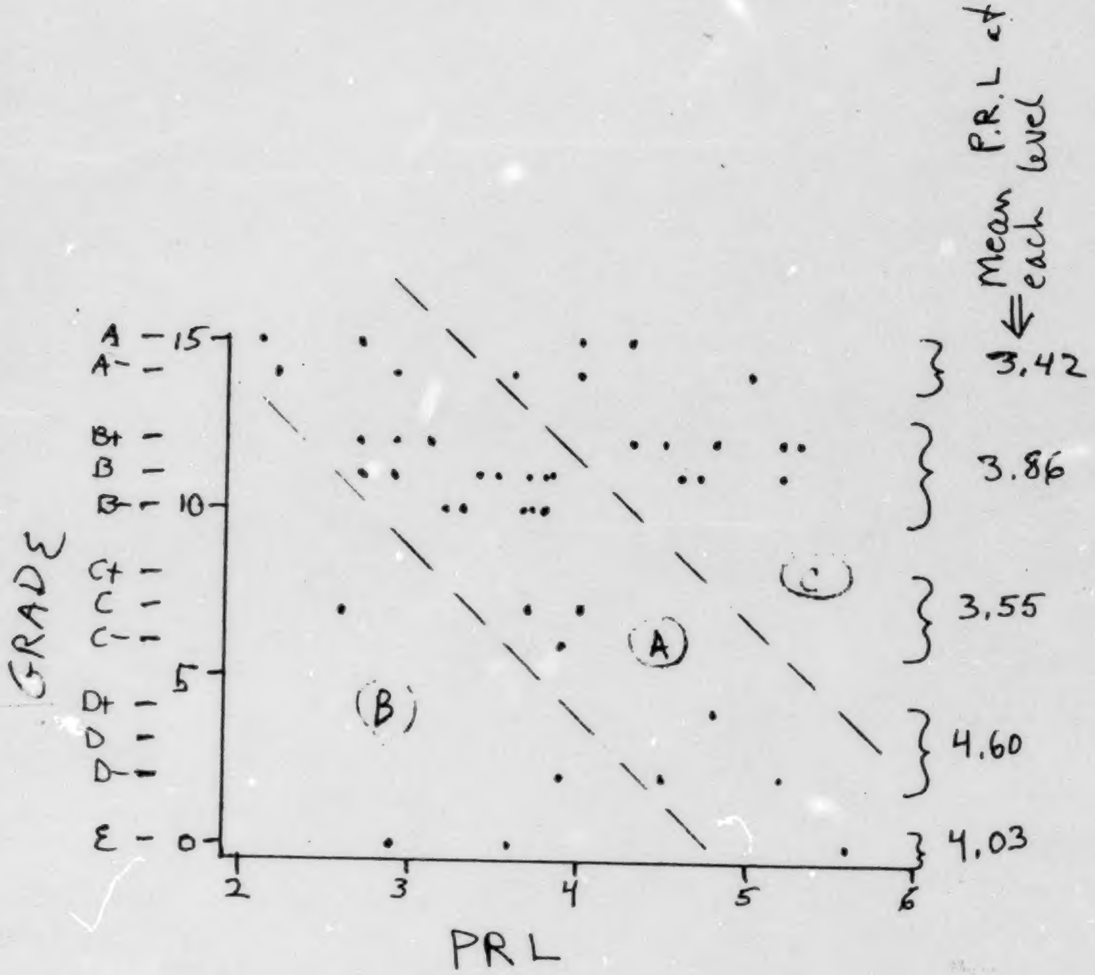
Bruce Collier

Bruce Collier

BC/av

Grade vs. P.R.L

Nat. Sci. 130
Fall Term 1971-72



P.R.L. for 43 students receiving letter grades:

Mean = 3.798
Sigma = 0.8854

VI-B-21

THE AIKEN COMPUTATION LABORATORY
DIVISION OF ENGINEERING AND APPLIED PHYSICS
HARVARD UNIVERSITY, CAMBRIDGE, MASSACHUSETTS 02138

4 April 1973

Dr. Dean Whitla
Office of Tests
University Hall 11

Dear Dean,

I have another question which I hope you can help me answer without too much effort on your part or your staff's.

As you may note in the next to the last line of the enclosed table 3, the proportion of students taking Nat Sci 130 pass/-fail has significantly declined over the three-year run of the course. I'd like to get some idea of how typical or atypical that is.

Last year Larry Stevens sent me a report giving some numbers for 1969-70, in particular, the percent of students who are taking a pass/fail course in their area of concentration, outside their area of concentration or anywhere at all. I should imagine that you would have the same figures for the three later years covered in my table 3. These figures might be enough to provide a basis for comparing Nat Sci 130 and college-wide trends.

Another set of figures might be useful, but since they are harder to get, I don't want to ask for them unless you happen to have them handy. The last two lines of table 3 break down the enrollment in Nat Sci 130 between those enrolled pass/fail and those enrolled for grade. Perhaps you have similar figures for other Nat Sci courses or perhaps for General Education courses in general. Such figures might provide a sharper trend comparison than just the percentage of students who are taking at least one pass/fail course.

Table 4b breaks down the bottom line figures of table 3 by area of concentration. You will note that the number of Nat Sci students who come into my course pass/fail runs counter to the trend. However, they are a small percentage of all students and those figures may not be significant. If table 4b is suggestive and you can give me some bases for comparison, I'd welcome them, but again, do not wish to put you to any special trouble.

My rock-bottom request therefore is for the three year trend in the percentage of students taking a pass/fail course and I'd like to have that as soon as possible even at the sacrifice of additional detail that you might be moved to supply.

Once again, many thanks for your help in this analysis.

Sincerely yours,

Anthony G. Oettinger

AGO:cmb

enclosures

	1970-71	1971-72	1972-73
P	35.9	21.4	10.0
F	1.0		
A	20.4	15.3	15.0
B	29.1	38.8	33.8
C	7.8	9.2	33.8
D	1.0	9.2	6.3
E	4.8	5.1	
INC		1.0	1.2
Total Number P/F	36.9	21.4	10.0
Total Number Grade	63.1	78.6	90.0

Table 3

Grade Distribution

		Fr.	Hum.	Soc. Sci.	Nat. Sci.	Other	Class
1970-71	P/F	30.4	30.0	46.5	36.7	16.7	36.9
	Grade	69.6	70.0	53.5	63.3	83.3	63.1
1971-72	P/F	0	30.4	20.0	75.0	25.0	21.4
	Grade	100.0	69.6	80.0	25.0	75.0	78.6
1972-73	P/F	0	3.8	16.1	50.0	0	10.0
	Grade	100.0	96.2	83.9	50.0	100	90.0

Table 4b

Percent in Area Selecting Pass/Fail or Grading

VI-B-25

Office of Tests
11 University Hall
April 5, 1973

Prof. Anthony G. Oettinger
Aiken Computation Laboratory

Dear Prof. Oettinger,

This letter is in reply to your inquiry to Dean Whitla concerning pass/fail grading. I am not certain I understand the nature of your concern, but I hope this information will help.

First, as to students in general taking courses pass/fail. Taking 1969-70 as a basis for comparison would be rather misleading, for that was the spring of the Cambodian invasion, and many students switched to pass/fail or other non-graded situations late in the spring term. Some figures are:

Year	% Pass/fail
69-70	26.9
70-71	8.8
71-72	10.7

These are for all students in all courses. I have no data for 1972-73.

The figures I have for Nat. Sci. 130 differ somewhat from yours. That is, according to the C.G.I. sheets, the percentage of students enrolled pass/fail was 38.7 in 70-71, and 22.2 in 71-72.

I have the following information for 1970-71 only. Percentage enrolled pass/fail in all General Education courses: 4.5%; for middle group Nat. Sci. Gen Ed. courses: 7.0%.

As to your Table 4b, I have the following thoughts. First, across the board, freshman are a bit less likely to enroll in courses pass/fail, which is also the pattern in your course. Second, to count for the General Education requirement, a course must be taken for a letter grade; since Nat. Sci. concentrators are unlikely to need Nat. Sci. 130 for the Gen. Ed. requirement under the current setup, it is likely that more of them will enroll pass/fail than other students. But probably the discrepancy is due to the small size of the group.

In sum, it appears that your course was at first out of line with the general pattern of pass/fail enrollments, but that it has now become much more normal.

I hope this somewhat meager information is helpful to you. Let me know if I can be of any further assistance.

Sincerely,

Bruce Collier

Dr. Bruce Collier

APPENDIX VI-C

Three-Year Comparisons

	1970-71	1971-72	1972-73
Humanities	19.4	23.5	32.4
Social Sciences	41.7	45.9	38.8
Natural Sciences	10.8	4.1	5.0
Other	5.8	8.1	3.8
Humanities and Social Sciences	61.1	69.3	71.2

Table 1

Percent of Class by Area of Concentration

	1970-71	1971-72	1972-73
Freshmen	22.3	18.4	20.0
Sophomore	19.4	22.4	17.5
Junior	33.1	23.5	25.0
Senior	23.3	31.6	35.0
Other	1.9	4.1	2.5

Table 2

Percent of Class by College Year

	1970-71	1971-72	1972-73
P	35.9	21.4	10.0
F	1.0		
A	20.4	15.3	15.0
B	29.1	38.8	33.8
C	7.8	9.2	33.8
D	1.0	9.2	6.3
E	4.8	5.1	
INC		1.0	1.2
Total Number P/F	36.9	21.4	10.0
Total Number Grade	63.1	78.6	90.0

Table 3

Grade Distribution

		Fr.	Hum.	Soc. Sci.	Nat. Sci.	Other	Class
1970-71	P/F	6.8	5.8	19.4	3.9	1.0	36.9
	Grade	15.5	13.6	22.3	6.8	4.9	63.1
1971-72	P/F	0	7.2	9.2	3.0	2.0	21.4
	Grade	18.4	16.3	36.7	1.0	6.2	78.6
1972-73	P/F	0	1.2	6.3	2.5	0	10.0
	Grade	20.0	31.2	32.5	2.5	3.8	90.0

Table 4a

Percent of Class Selecting Pass/Fail or Grading

		Fr.	Hum.	Soc. Sci.	Nat. Sci.	Other	Class
1970-71	P/F	30.4	30.0	46.5	36.7	16.7	36.9
	Grade	69.6	70.0	53.5	63.3	83.3	63.1
1971-72	P/F	0	30.4	20.0	75.0	25.0	21.4
	Grade	100.0	69.6	80.0	25.0	75.0	78.6
1972-73	P/F	0	3.8	16.1	50.0	0	10.0
	Grade	100.0	96.2	83.9	50.0	100	90.0

Table 4b

Percent in Area Selecting Pass/Fail or Grading

	1970-71	1971-72	1972-73
Number Applying	150	221	199
Number in Class	97	98	80
$\frac{\text{In-Class}}{\text{Applicants}} \times 100$	65	44	40

(a) Overall

	1970-71	1971-72	1972-73
Fr.	72	42	35
So.	56	45	34
Jr.	89	49	36
Sr.	47	46	53
Other		33	50

(b) $\frac{\text{In-Class}}{\text{Applicants}} \times 100$ by College Year

	1970-71	1971-72	1972-73
Fr.	72	42	35
Hum.	61	42	41
Soc. Sci.	64	48	49
Nat. Sci.	61	33	36
Other		44	43

(c) $\frac{\text{In-Class}}{\text{Applicants}} \times 100$ by Area of Concentration

Table 5. Comparative Composition of Class and Applicant Pool

Table 6

Three-Year Summaries of Significant Questionnaire Data from Appendices III, IV and V

		'70-'71	'71-'72	'72-'73
a. Percent of class returning questionnaires		60	64	63
b. Percent of respondents indicating high interest in course*		50	46	28
c. High interest respondents by grade (circles indicate four or less respondents)				
	A	56	63	42
	B	50	50	33
	C	50	(75)	28
	D	⓪	⓪	㊿
	Pass	48	20	0
d. Percent of class taking course pass/fail (see also Table 4)		37	22	10
e. Percent of graded respondents indicating that fulfillment of the Nat Sci requirement was their main consideration in choosing grading over pass/fail		N.A.	63	81
f. Percent of graded respondents indicating they got the grade they expected		N.A.	33	12
g. Effect on respondents' outlook on science and technology				
Percent of Responses	Positive	65	59	58
	Negative	8	11	6
	No effect	24	30	30
	No answer	3	0	6
h. Percent of respondents reporting favorably on broad range of interesting topics		76	70	56
i. Percent of respondents reporting negatively on superficiality of course content		29	38	30

---

* In terms of Appendices III-V, "high interest" here excludes "middle interest" hence tends toward understatement of high interest.

Table 6 - Continued

	'70-'71	'71-'72	'72-'73
j. Percent of respondents reporting negatively on excessive freedom and insufficient structure in course	11	14	16
k. Percent of respondents reporting follow-up activities -- courses, projects, papers, future plans -- they would not have considered otherwise	52	68	56
l. Percent of respondents reporting that they liked their project	63	67	66
m. Percent of respondents reporting that they liked the staff	61	41	42
n. Percent of respondents reporting favorably that the course was experimental	52	51	44
o. Percent of respondents reporting negatively that the course lecture format was too traditional	N.A.	17	10
p. Percent of respondents reporting that they enjoyed using videotape	N.A.	78	78
q. Percent of respondents reporting that videotape project was a pain	N.A.	10	6
r. Percent of respondents reporting they would take course again			
yes	73	73	59
no	11	10	17
undecided	13	10	24
no answer	3	7	0
s. Percent of respondents reporting they would take course again in absence of General Education requirement			
yes	N.A.	67	42
no	N.A.	15	32
undecided	N.A.	18	24
no answer	N.A.	0	2

APPENDIX VII

Diary Evaluation Analysis

1970-1971

MEMORANDUM

VII-1

To Tony

From Michele

Date April 12, 1971

Subject Nat. Sci. 130 Diary
Evaluations data

Here are the first figures back of the data from the diary evaluation check lists. The report with percentages will follow; right now there are only the raw figures. A brief note about some of the data:

the 'No answer' category does not reflect too much on the diary of the particular student so much as on the person evaluating (with exceptions for diaries that contained nothing but reading notes, etc.) ?

-- there are only 83 checklists and my base is ~~83~~ 104. This is due in some part to the fact that some people did not complete their assigned evaluations. Wick Nichols did not do any as yet. However, with a base of ~~83~~ 104 a full 20% of Nat. Sci. 130 was left unevaluated by this diary check list.

-- the 'Other' category represents people who said pos + neg on the B part and people who said medium on various questions of part A. This category also includes those people who really did have an 'other' statement.

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HARVARD UNIVERSITY
A.M. 271/Nat. Sci. 131
Spring 1971

Nat. Sci. 130 Diary Evaluation Check List

83
21 not represented
104

M 59 F 24
Freshman 16
Sophomore 17
Junior 29
Senior 19
Grad. Student 2

Humanities 13
Soc. Sci 42
Nat. Sci 10

A.

1. On balance, the attitude toward Nat. Sci. 130

at the start is:	Class	M	F	Fr	So	Jr	Sr	Hum	S S	N S
None	30	22	8	4	3	13	7	6	14	3
Enthusiastic	18	13	5	2	6	6	2	1	10	3
Positive	12	10	2	2	3	2	5	1	7	2
Neutral	12	8	4	0	3	4	2	2	5	2
Quizzical	7	4	3	0	2	3	2	2	5	0
Negative	1	1	0	1	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	0
No Answer	3	1	2	7	0	1	1	1	1	0

at the end is:										
None	24	18	6	4	4	11	5	4	12	4
Enthusiastic	14	9	5	3	5	3	3	2	7	3
Positive	20	15	5	5	3	6	5	2	10	2
Neutral	7	5	2	1	2	4	0	1	5	0
Disappointed	11	7	4	1	2	4	4	3	7	0
Negative	1	1	0	0	1	0	0	1	0	0
Other	0	0	0	0	0	0	0	0	0	0
No Answer	6	4	2	2	0	1	2	1	1	1

2. The course was

	Class	M	F	Fr	So	Jr	Sr	Hum	S S	N S
concentrated:										
Too much	2	2	0	1	0	0	1	0	1	0
Just right	10	7	3	3	4	1	2	0	5	2
Too little	11	6	5	1	2	5	3	1	8	1
No comment	47	34	13	8	9	19	11	11	23	5
Other	2	2	0	0	1	1	0	0	2	0
No answer	11	8	3	3	1	3	2	1	3	2
flexible:										
Too much	4	3	1	1	0	1	1	0	1	1
Just right	21	14	7	6	4	7	4	3	11	1
Too little	5	3	2	1	1	2	1	0	4	0
No comment	46	34	12	6	11	17	12	9	24	7
Other	0	0	0	0	0	0	0	0	0	0
No answer	7	5	2	2	1	2	1	1	2	1
3. Attitude toward Diary is:										
Positive	34	21	13	8	7	9	9	2	19	4
Neutral	35	29	6	8	6	13	8	5	18	4
Negative	9	6	3	0	3	4	2	4	4	1
Other	1	1	0	0	0	1	0	0	1	0
No answer	4	2	2	0	1	2	0	2	0	1
4. Diary Quality:										
a. Total of readings is:										
Non-existent	3	3	0	0	2	1	0	1	2	0
Sparse	15	13	2	3	4	4	4	0	9	3
Medium	29	23	6	6	6	12	5	7	11	5
High	24	14	10	6	3	8	6	3	13	1
Massive	2	0	2	0	1	1	0	1	1	0
Other	3	2	1	0	0	1	2	1	2	0
No answer	7	4	3	1	1	2	2	0	4	1
b. Reading Notes are mainly:										
Summary notes	17	11	6	2	3	9	3	6	6	3
Pers. reactions/ques	27	22	5	5	7	8	7	4	14	4
A mix of both	33	20	13	7	5	11	9	3	18	3
Sparse	27	23	4	6	8	8	5	5	11	5
Medium	24	19	5	4	6	6	8	2	15	3
Extensive	15	5	10	1	2	8	3	3	8	1

4. c. Percent of titles read is distributed roughly as follows:

Required or suggested:

	Class	M	F	Fr
1- 25%				
30- 50%				
60- 75%				
80-100%				

Otherwise motivated:

1- 25%				
30- 50%				
60- 75%				
80-100%				

d. Reading in sources tends to be:

	Class	M	F	Fr	So	Jr	Sr	Hum	S S	N S
Selective	39	29	10	9	11	13	6	7	18	5
Exhaustive	28	15	13	3	4	9	11	6	14	3
Other	3	3	0	1	0	2	0	0	2	0
No answer	13	12	1	3	2	5	2	0	7	2

5. Project notes are:

Absent	23	17	6	2	7	6	8	7	8	6
Sparse	29	22	7	5	5	14	5	4	16	4
Copious	20	13	7	5	3	8	3	2	11	0
Other	7									
No answer	4	4	0	2	0	1	0	0	1	0

6. Lecture notes are:

Absent	25	20	5	5	4	11	5	3	14	3
Sparse	22	20	2	2	5	8	7	4	11	5
Copious	24	12	12	6	5	8	4	4	12	1
Photographic	22	11	11	4	4	8	5	4	9	4
Inter/Ques	27	20	7	4	7	7	9	5	15	3
Other	9	7	2	1	2	4	2	1	6	1
No answer	not applicable									

B. Comments on specific matters - Please rate: None Positive Neutral Negative

		Non	Pos	Neu	Neg	Oth	No A
1.	Math	49	9	7	15	1	2
2.	FCC Panel	57	9	2	13	0	2
3.	ESP Panel	56	7	2	16	0	2
4.	Law School Session -setting	53	26	2	0	0	2
	b. Topic	51	21	4	2	1	4
5.	Telephone Exchange videotape	55	17	4	5	0	2
6.	Fink "Sawtooth" videotape	64	6	6	5	0	2
7.	Zapol film	55	16	5	3	1	3
8.	Bossert "Bit" lecture	56	9	7	8	0	3
9.	Bossert "Animal" lectures	49	21	6	2	2	3
10.	Oettinger Telephony lectures	57	14	3	6	0	3
11.	Land lectures	48	22	6	6	0	2
12.	Schroeder lectures	50	17	5	9	0	2
13.	Fink/Popek Computer lecture	59	2	5	12	2	3
14.	Oettinger "Compunications" paper	49	17	8	5	0	4
15.	Sebeok reading	56	8	7	8	1	3
16.	First Circle reading	72	4	2	1	0	4
17.	Scientific Amercian readings	54	19	4	2	1	3
18.	Accessibility of reading matter	67	2	0	11	0	3
19.	Anechoic chamber visit	69	10	1	0	0	3
20.	Jordan J dinners	71	6	2	0	0	4
21.	Wine tasting	72	6	1	0	1	3
22.	Films - in general	55	18	2	1	1	6
23.	Before/after class festivities	65	9	3	0	0	6
24.	Matthews Basement Studio	70	3	0	2	1	7

FIGURES ARE FOR WHOLE CLASS OF 83

APPENDIX VIII

Scientific American Reading Analysis

1970-1971

MEMORANDUM

To Tony

From Michele

Date February 12, 1971

Subject Scientific American Tub File Usage

Data is gleaned from Sign-out cards only.

Breakdown by students

50 different students used the Tub File at least once (according to signout cards).

4 students used the file only once (8% of use)

28 students used the file 2 - 5 times (14 used it only two times) (56% of use)

11 students used the file 6 - 10 times (22% of use)

7 students used the file more than 10 times. (14% of use)

(Gerarde - 19, Rault - 17, Stoeckle - 16, Aronson - 13, Jaslow - 12, Greenberg - 12, Kaiser - 11.)

Average use by the 50 students is 5.32 times (11%)

Breakdown by Sign-out cards

72 cards were used (72 different articles)

18 cards were unused (18 articles)

1 card was missing (to my knowledge)

4 cards were signed out only by members of the staff or the Nieman Fellow

18 cards were signed out by only one student (use does not include staff)

38 cards were signed out by 2-5 students "

7 cards were signed out by 6 - 10 students "

5 cards were signed out by more than 10 students "

Average use of the 72 article sign-out cards is by 3.51 students

Used most often

Hallucinogenic Drugs - 8, Forgetting - 9, Communication Satellites - 14, Pheromones - 15, Pulse Code Modulation - 15, Telephone Switching - 17, How Slime Molds Communicate - 17.

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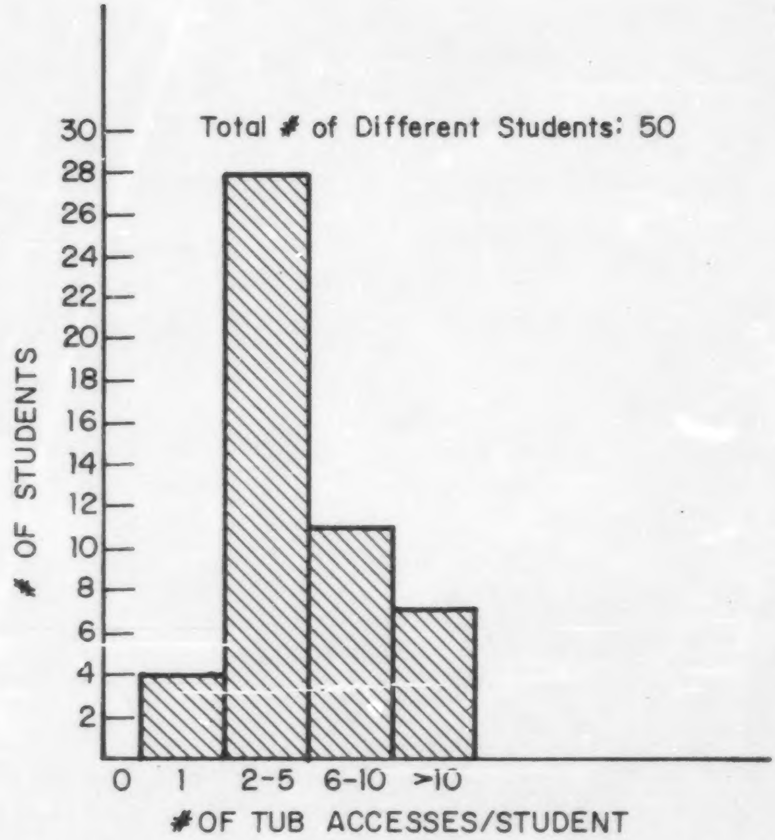
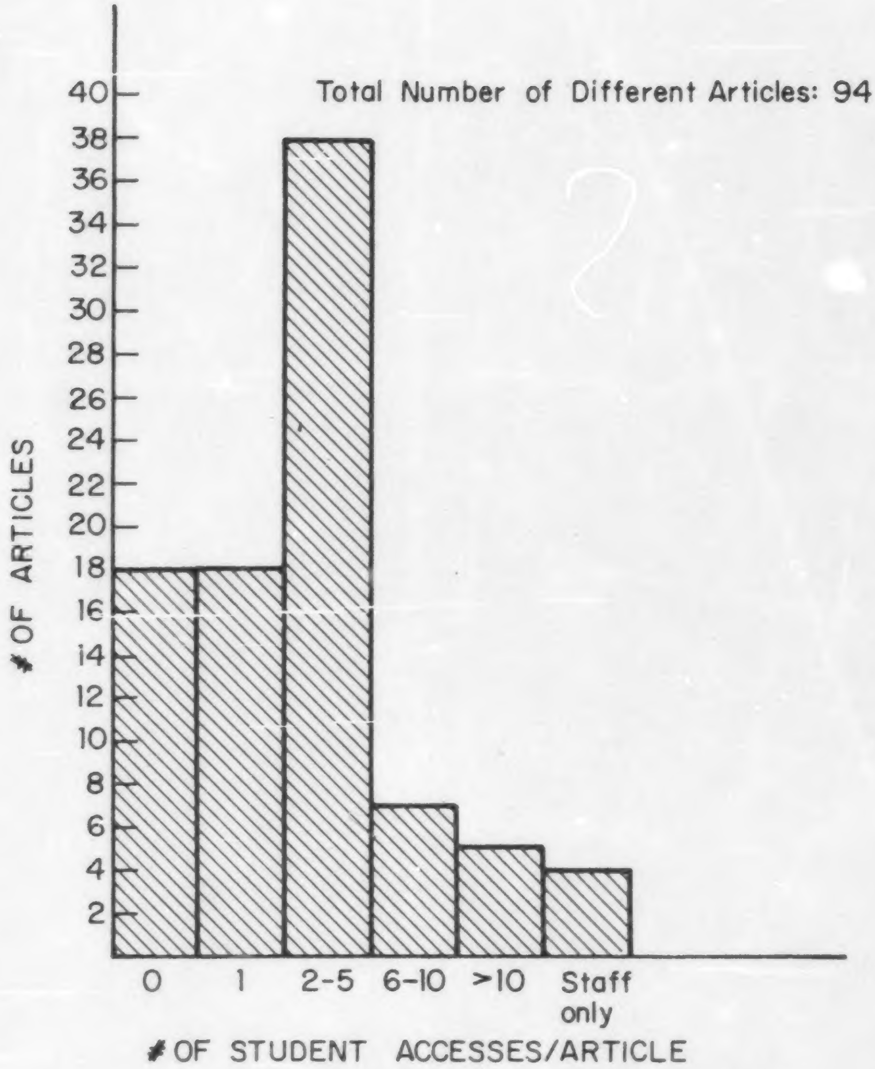


Student Access Rates to Scientific American file



Use Distribution of *Scientific American* articles

APPENDIX IX

Videotape Production Notes

APPENDIX IX-A

On-Line Videographic Output

On-Line Videographic Output*

by

Robert E. DesMaisons

October 19, 1970

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* This was an invited report presented at a special session on "Applications of Video Graphics" at the 1970 UAIDE Conference under partial support of NSF Contract GY-6181 and a contract between Harvard University and the IBM T.J. Watson Research Center.

The remarks I would like to make concern the use of an on-line videographic medium in producing a finished presentation of graphical material. The actual content of the videographic presentation in question resulted from work done at Harvard University under contracts with IBM Research and NSF in which some of the graphical techniques of an interactive computer system, entitled THE BRAIN, were being documented using the system itself. The graphical output was generated on a Tektronix storage scope-scan converter unit which allowed simultaneous video recording on our 1-inch Sony videocorder.

Considerable time and effort was spent in preparing the graphical content of the presentation by programming the computer system to generate successive graphical frames; but the important point to note is that this preparation of the computer system would have been necessary whether the recording of the material was made on videotape, on Polaroid slides, on the CALCOMP plotter, or on a movie film. And so one need only be concerned with the relative economics, time, and dynamics of the recording media after the computer system has been setup with the content of the presentation.

The 16 mm film which accompanies this paper is a direct copy of the actual videotape recording to which I have been referring. In fact there are places in the film where it is evident that this is a copy of video output; but what should be noted from the film is the dynamic value of presenting the graphical material in this form and its ability to "get the point across" as compared to a corresponding slide presentation or paper report on the same material.

During the early stages of working on this presentation, a version of the script was reviewed by some of the people in the IBM graphics research group who commented very politely, "Yes - that's very nice." - but who, upon seeing it coupled with the actual graphic presentation via the computer remarked with much more enthusiasm, "Now I really understand the points that you're trying to make!". So it was clear that the content of the presentation required a strong graphical boost in order to attain some degree of clarity. But what made the construction of the report a relatively easy and inexpensive job was the combination of the graphics with the video.

Once the content of the video script had been decided upon, it took a total of two hours recording and editing time to produce the final 30-minute videotape. Thus, two hours of my time plus the computer time used during the recording, and the cost of the videotape reel comprised the total cost of the actual recording itself - or on the order of $2 per minute of videotape output.

However, working with the videotape during developmental stages of the graphical presentation does not preclude the possibility of eventually producing a film to allow for wider distribution of the end product. The film which accompanies this paper was copied from the videotape at approximately $10 per minute for the initial answer print and $50 total for each subsequent copy. These figures can then be contrasted to the estimated costs of producing a film directly from the scope without any use of the videotape. One would make the assumption again that the graphical script had been programmed into the computer beforehand, that the filming would be done by a non-professional, and that the end product would be a film of similar quality. Based on these assumptions the cost estimates for producing the 30-minute film (raw stock, laboratory processing and editing) are in the vicinity of $2000 or $65 per minute.

Considering the convenience of viewing immediately what is being recorded, the cost factors involved, and the fact that the videotape can be reused, added to and edited, it seems logical that the combination of video with the graphics has significantly more to offer than does film with the graphics - at least on the non-professional level.

I would like to stress the fact that the production of the videotape recording - aside from suggestions and criticisms on the content of the material - was a one-man effort. This includes the computer programming, the audio script, and particularly the videotaping and editing. This is neither a pat-on-the-back nor an apology, but simply a statement that with this type of videographic setup it is possible for someone without any elaborate filming background and with no more video recording and editing knowledge than that gained by reading the instruction manual on how to operate the video recorder - can produce a presentable piece of graphical material at considerably less cost than a direct film and with considerably more editing flexibility than a direct film.

Given the appropriate content of the material, it is possible to significantly improve the dynamic effectiveness of the material over what might be obtained with slides or a paper presentation. And, lest I alienate forever all those people who believe "The movie is the thing", one still has the option of turning the videotape into a film for wider circulation and availability.

APPENDIX IX-B

Synthesis of "Synthesis of a Sawtooth"

Synthesis of "Synthesis of a Sawtooth"

The Project

In planning for a Nat Sci 130 lecture on Fourier synthesis and the analysis of linear and non-linear amplifiers, Dr. Oettinger asked me to prepare a videotape demonstration on THE BRAIN. The lecture was intended for a non-technical group so it was important to present ideas and results without the (seemingly difficult)mathematical derivations and relations.

I was interested in experimenting with an animated tape that could convey most of the important concepts and not merely serve as an articulate blackboard, but time constraints (and an impending examination) led me to attempt the project in its simplest form. This was probably the best choice even had infinite time been available. (See below.)

My Background

I had been exposed to THE BRAIN briefly in Applied Math 272 and had seen two videotapes describing it, but had never worked out any complete problem on THE BRAIN and was familiar with only a limited repertory of its commands. So I began by obtaining a copy of"THE BRAIN Users Reference Manual" and perusing its list of operator definitions. (This manual would have been quite difficult had I not had some prior exposure to THE BRAIN.)

I was intimately familiar with the mathematics involved in the demonstration, and had an extensive background in interactive computing.

Working Sessions

I came to the first session with a rough idea of what displays I wanted, but was determined to work interactively in designing the displays as well as in implementing them. For the first session I played with various sine-wave summations and learned how to define appropriate operators which would let me pass parameters. But I used only single letter names (mode 0) and quickly got confused in keeping track of arrays, variables, and operators. The ability to show things on hard copy would have been helpful. Like most of the sessions, this one lasted approximately one hour.

In the second session I began by defining my operators and variables with meaningful names, and then spent most of the session learning how to construct and invoke formats. At the end of this session I had developed the operators to construct and display the Fourier synthesis sequence, but had not yet chosen the coefficients to use in the expansion.

Most of the third sequence was spent looking at different expansions and building operators to show them. I was held up by some bugs I encountered in the parser implementation (I didn't realize this until later) and by some program bugs I introduced by spelling out upper keyboard operators on the lower keyboard.

I began to look at transfer functions at the end of the third session but didn't really learn how to use the EVAL operator until the fourth. I then defined appropriate formats and operators to display the transfer function and the signal both before and after amplification.

During the fifth session I defined.a series of transfer functions and input signals and studied their display characteristics. Finally I defined operators for the title and so thought that I was ready to videotape. However, when we started videotaping during the sixth session we found that I was still catching the parser bugs and that in my final editing I had introduced a few more "keyboard bugs". During this session we finally realized how I was catching parser bugs and corrected the programs correctly.

We videotaped the whole sequence in the seventh session, but then found that there had been problems with the video-recorder and so had to make another (identical) tape during the eighth session.

Accounting
For Time

Thus about six hours were expended in creative work at THE BRAIN terminal, and two were primarily occupied in videotaping. (Neither of the videotaping sessions used the full hour available.) The sixth session was primarily consumed in removing bugs that I introduced through unfamiliarity with the system, and much of the second session was occupied in exploring the operation of the system. This means that about four hours were actually spent using THE BRAIN for the project. Of that time, about half was spent defining the displays and half looking at different functions and coefficients to pick the most instructive and visible displays.

The final tape produced ran for about fifteen minutes. An upper bound to the preparation/use ratio is therefore 32:1. However, much of the preparation time was spent developing operators and formats that could be used to produce other displays or which students could use as a beginning for exploration on THE BRAIN. With starts and stops for explanation, the tape was used for about 2 hours in two class sessions. A lower bound for the ratio is therefore 4:1, if the tape is never used again.

Critique

THE BRAIN was almost an ideal system for preparing this videotape. It was easy to define new operators and study their effects, while display formats could be defined separately and modified only when necessary. As I mentioned above, hard copy output would occasionally have been helpful and several "bugs" were encountered but, on balance, I think that THE BRAIN should be praised and given only slight rebuke.

It is hard to know how helpful the videotape was in class because we have no standard for comparison. Several students did tell me that it was the best use of the video facilities they have yet seen in Nat Sci 130, and I received none of the complaints that accompanied all previous video demonstrations. But the fact that the demonstration was received positively does not indicate how successfully we realized the full potential of the medium. None of the comments from students pointed towards specific improvements. Staff members in the course have suggested that coordinate systems and scales might have been shown explicitly, but have made no more far-reaching suggestions.

I personally felt that the videotape effectively illustrated the key concepts and was not obscured by extra details, that it was used well in conjunction with the lecture, and that the technological details did not obscure the essential message. (The most frequent criticism I heard of the use of THE BRAIN in Linguistics 104 last year was that the presence of THE BRAIN terminal in the classroom was itself a distraction, and that much time was wasted in creating displays.) It was especially helpful to have long sequences of each display so that students could continue to watch it after the explanation was complete. In this way, the television monitors provided an effective focus for student attention throughout the lecture.

I suggested above that the (forced) choice not to include audio was fortuitous. This is because the professor speaking while the tape was playing was able to "punctuate" the tape and adjust the information rate (by starting and stopping the tape) to keep pace with the class. A continuous uninterrupted sequence would have required more concerted attention and might have been more difficult to comprehend. Slides would also have permitted this "punctuation" but they might have been a distraction tending to break up the whole lecture sequence. The videotape permitted breaks but did not require them.

Arthur Fink

APPENDIX IX-C

Production of "Hermit Crab Communication"

The following is an approximate breakdown of the time spent making the video tape "Hermit Crab Communication."

BEST COPY AVAILABLE

2 days	Research project. This entailed reading litterature in the library. Additional reading was done after the shooting was completed but before the final writing of the script.
8 days	Videotaping the hermit crabs.
(3)	Vidoetaping in laboratory conditions. Instead of taking 1 day, it was necessary to shoot the crabs 3 days because of problems with the equipment. The Bell and Howell camera, which was preferable to the Sony AVC-3400 in that the Bell and Howell allowed for better resolution and a closer shooting range, cannot be used with the Sony AV-3400 1/2". The first trial failed and an adaption was made which also failed to correct the incompatibility between the two machines. Finally the crabs were transported to an area where the Bell and Howell could be hooked up to the Sony EV-200 1" tape deck. The crabs, however, reacted even more unfavorably to their new laboratory conditions and, consequently, the sections videotaped did not include natural behavior.
(2)	Videotaping on location. This involved two trips.
(3)	In order to videotape on location, it was necessary to prepare in advance for the trip. The 3 days were spent a. Getting the proper equipment and making certain that it was in working order. b. Arranging for assistants to help with the shooting. (In this case, gathering and holding the crabs.) c. After the first trip, looking at the material to decide what was still needed.
7 days	Writing the script. Initially, the tapes were viewed and catalogued. The script was then written based on the research and the available shots. This process was time consuming, because it was necessary to find which shot illustrated a particular point best and, at the same time, had continuity with the preceeding sections.
6 1/2 days	Trial tape. All videotape recorded on 1/2" tape was transferred to 1" tape. The incompatibility of the signals between the tape initially shot on the AV-3400 1/2" recorder and transferred to 1" tape and the tape initially recorded on the 1" recorder caused a great deal of difficulty in making clean edits. After trial and error, I learned to listen for the right sound when both the 1" tape recorders were in forward mode and ready for the edit. I also spent time teaching myself how to make exact as well as clean edits (which do not always occurr even if you do not have the problem of incompatibility between 1" and 1/2" recorded tape).

2 days	Until the actual editing of the final tape, time was spent talking to the lecturer who would use the tape. As a result of these conversations, the last section of the script was rewritten.
2 days	Titles. These were made with the Gen-Lock and time was spent in learning how to use this machine. The actual process of lettering the titles was very time consuming.
5 days	Final edit. This time it was necessary to have the timing of the shots accurate.
1 1/2 days	Find appropriate music for titles. Dub on sound track.

Carol Weinhaus

APPENDIX IX-D

Videotape Editing

VIDEOTAPE EDITING

by

Carol Weinhaus

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VTR EDITING CAPABILITIES

Sony EV-320F 1" VTR

This will give you the cleanest edits. The properties of its three editing modes are as follows:

RECORD and PLAY/REC

A straightforward recording process. However, there will be noise at the beginning and at the end of your recording.

ADD ON and SAFETY

Allows you to add sections to a tape, with clean edits at the beginning of each shot. It is an additive process giving good edits only at the beginning of each shot and noise whenever you stop recording.

It will give you audio on channel 1 without effecting the audio on channel 2. You cannot dub sound onto channel 1.

CUT IN and SAFETY

This mode, in conjunction with CUT OUT, allows you to insert sections within a pre-recorded tape and gives good edits at both the beginning and end of the insert. You can also use it in an additive process [in the same manner as you use ADD ON].

CUT IN will give you audio on channel 2 without effecting the audio on channel 1. It is possible to dub new sound on channel 2 at a later time. If you think you will want to use original sound and dubbed sound without mixing the two, do your editing with CUT IN.

NOTE: You must have a previously recorded sync track on your tape to be able to use CUT IN. You can do this by either recording a video signal on the tape by using ADD ON or PLAY/REC and RECORD or you can lay a sync track by blanking your tape with the PLAY/REC and RECORD buttons.

Sony AV-3650 1/2" VTR

The edits are often not as clean as those done with the Sony EV-320F. There is also a larger time lag [approx. 2 seconds] between the time the video first appears and the audio appears when you edit.

CONNECTIONS FOR EDITING FROM A 1/2" VTR TO A 1" VTR.

MONITOR	1/2" VTR	1" VTR	MONITOR
	VIDEO OUT coaxial cable	VIDEO IN	
	LINE OUT Sony 1-prong --audio cable-- cannon male	CHANNEL 1 IN or CHANNEL 2 IN switches on HIGH and 600Ω ON	
VTR Sony 8-prong --camera cable-- Sony 8-prong	TV		
		MONITOR VIDEO OUT AUDIO CHS 1 + 2 OUT female cannon + coaxial --camera cable-- female Sony 8-prong -- male Sony 8-prong --camera cable-- male Sony 8-prong OR MONITOR VIDEO OUT coaxial cable ADUIO CHS 1 + 2 OUT female cannon --audio cable-- Sony 1-prong	VTR EXT IN EXT IN

CONNECTIONS FOR EDITING FROM A 1" VTR TO A 1" VTR

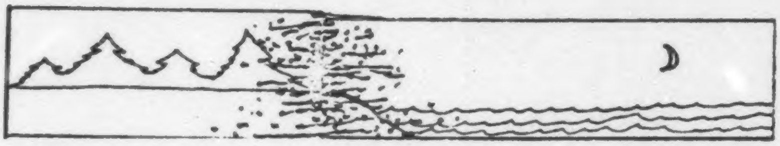
AMPLIFIER	MONITOR	1" VTR	1" VTR	MONITOR
		VIDEO OUT	VIDEO IN	
		coaxial cable		
		AUDIO CH-1 or CH-2 OUT switches on HIGH and 600Ω ON	AUDIO CH-1 or CH-2 IN switches on HIGH and 600Ω ON	
		female cannon --audio cable-- male cannon		
			MONITOR VIDEO OUT AUDIO CHS 1 + 2 OUT	VTR
			female cannon + coaxial --camera cable-- female Sony 8-prong --- ---male Sony 8-prong --camera cable-- male sony 8-prong	
			OR	
			MONITOR VIDEO OUT	EXT IN
			coaxial cable	
			AUDIO CHS 1 + 2 OUT	EXT IN
			female cannon -- audio cable -- Sony 1-prong	
	VIDEO IN	MONITOR VIDEO OUT		
	coxial cable			
IMPUT female cannon	------audio cable -------female cannon	MONITOR AUDIO CHS 1 + 2		

CONNECTIONS FOR EDITING FROM A 1/2" VTR TO A 1/2" VTR

MONITOR		1/2" VTR		1/2" VTR		MONITOR
		VIDEC OUT	coaxial cable	VIDEO IN		
		LINE OUT Sony 1-prong	-- audio cable --	AUX IN Sony 1-prong		
VTR Sony 8-prong	-- camera cable --	TV Sony 8-prong				
				TV Sony 8-prong	-- camera cable --	VTR Sony 8-prong

VIDEOTAPING FOR EDITING

Editing is an additive re-recording process rather than a cutting and splicing one. When you tape for editing, leave at least 15-20 seconds before the beginning and at the end of each shot. Otherwise, you will have noise where your edit starts or where your next edit will be.



noise

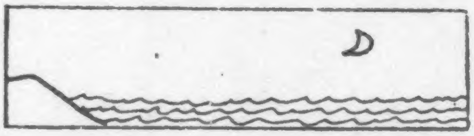
If you know when you want your audio to end and you are using a recorder that has manual audio control, use the following procedure:

1. Turn the sound down and start videotaping.
2. At the beginning of the section you want to use, turn up the sound.
3. Turn down the sound at where the edited shot ends but let the video record 15-20 seconds more before you switch the VTR to stop.

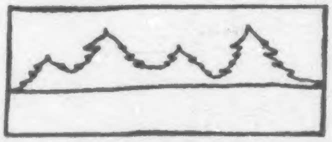
TERMS USED IN EDITING EXPLANATION

For the explanation of editing videotape the following terms and example will be used.

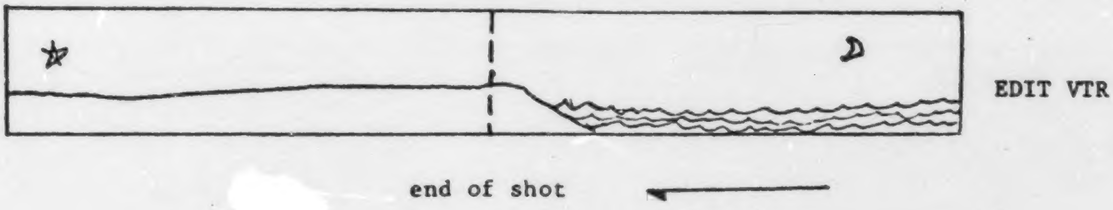
A shot of the seashore is on your final videotape.



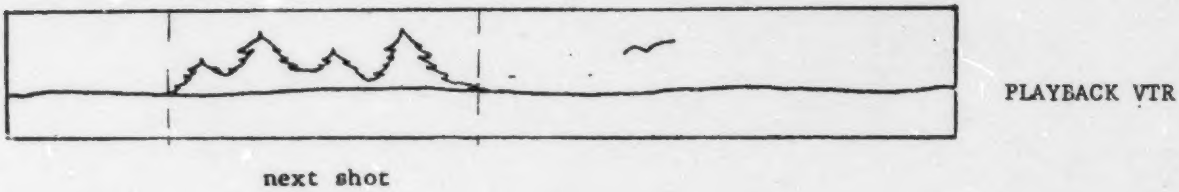
You want to add a shot of the forest next.



Your final videotape [the one which you are adding shots onto] is played on the editing VTR, which will be referred to as the EDIT VTR.


EDIT VTR
end of shot

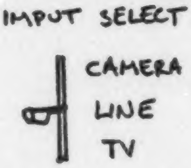
The videotape from which you are taking you next shot is played on the other VTR which will be referred to as the PLAYBACK VTR.


PLAYBACK VTR
next shot

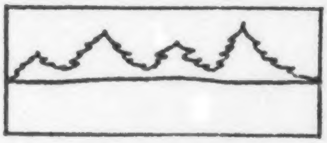
CHECKING LEVELS

Before you actually make your recording, you should adjust the tracking, video, and audio levels. In addition, the appropriate switches must be in the correct position.

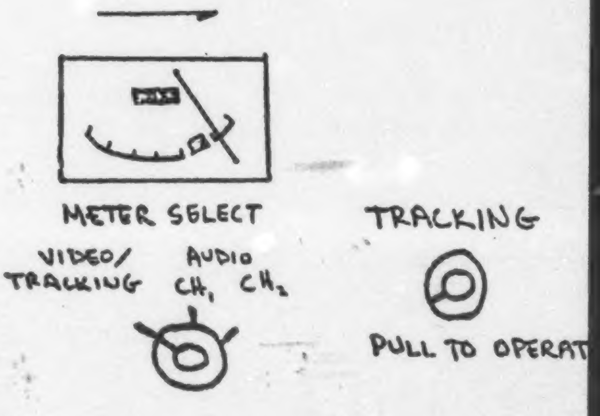
On the AV-3650, set the IMPUT SELECT switch to LINE.


IMPUT SELECT
CAMERA
LINE
TV

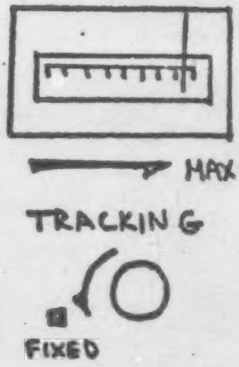
Set the PLAYBACK VTR in playback mode. This is the PLAY/REC button on the EV-320F or EV-310 and FORWARD on the AV-3650. Find the section of the tape you want to add.

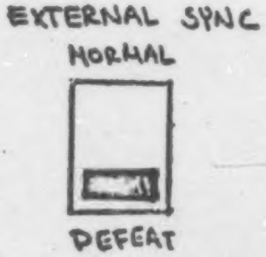


Adjust the tracking on the PLAYBACK VTR. On the EV-320F or EV-310, set the METER SELECT button to VIDEO. Then pull the TRACKING knob up and turn it either left or right to achieve maximum deflection of the meter needle to the right.


METER SELECT
VIDEO/ TRACKING
AUDIO CH1 CH2
TRACKING
PULL TO OPERAT

To adjust the tracking on the AV-3650, turn the tracking knob so that the meter needle achieves maximum deflection to the right.


MAX
TRACKING
FIXED


EXTERNAL SYNC
NORMAL
DEFEAT

If you are using the EV-320F for playback, the EXTERNAL SYNC switch should be on DEFEAT.

To check the video and audio levels on the EDIT VTR, have the section you want to add playing on the PLAYBACK VTR.

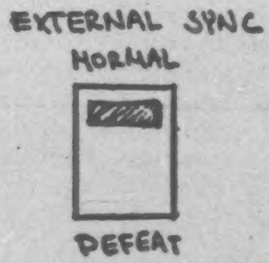
PLAYBACK VTR

Then press RECORD only on the EDIT VTR. You now have the same image and sound on both monitors.

PLAYBACK VTR

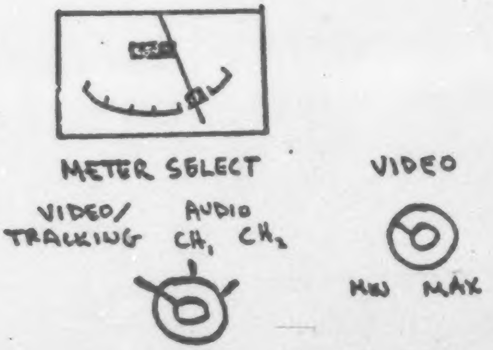
EDIT VTR

If you are using the EV-320F as your EDIT VTR, the EXTERNAL SYNC switch should be on NORMAL.

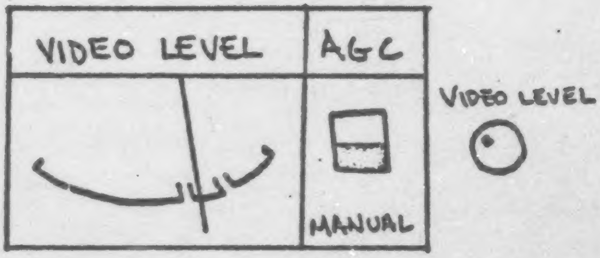

EXTERNAL SYNC
NORMAL
DEFEAT

CHECKING THE VIDEO LEVEL

To check the video level on the EV-320F, turn the METER SELECT knob to VIDEO/ TRACKING and adjust the VIDEO control knob so that the needle lies within the blue area.



To check the video level on the AV-3650, set the VIDEO LEVEL switch to MANUAL and adjust the VIDEO LEVEL control knob so that the needle lies within the blue area.

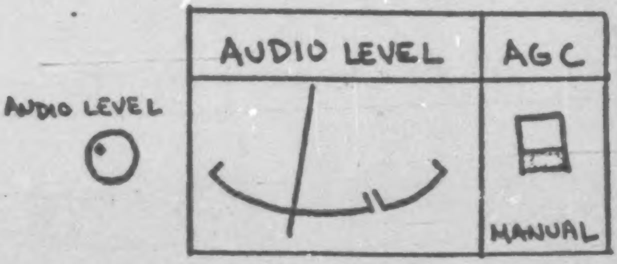


CHECKING THE AUDIO LEVEL

If you are going to dub on an entire new sound track at a later time, you do not have to check the audio level, or even use the audio cables to connect the VTRs. However, if you are going to use existing sound as is or in a mix with other sound imput, the following procedure will avoid confused sound tracks at edit points and, on the EV-320F, loud clicks at the edit points:

> When you set the audio level, note the position of the black mark on the control knob, -- either by theletter it points to or its direction. Then turn the audio level down completely. Turn up the audio level to the predetermined position immediately after you make your edit.

To check the audio level on the AV-3650, set the AUDIO LEVEL switch to MANUAL and adjust the AUDIO LEVEL control knob so that the needle oscillates within the left half of the green area and does not peak into the red area.

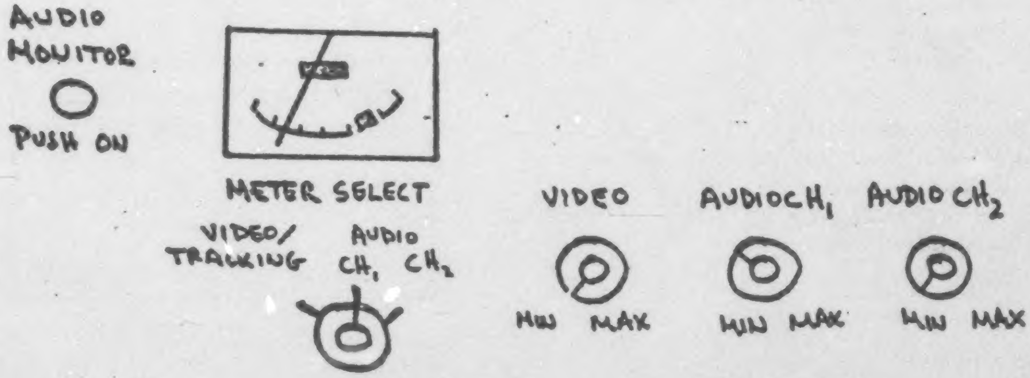


To check the sudio level on the EV-320F, turn on the AUDIO MONITOR button. Otherwise, you won't be able to hear the sound even though you may be recording it. Turn the METER SELECT knob to the appropriate channel.

Channel 1: If you are using ADD ON or RECORD + PLAY/REC .

Channel 2: If you are using CUT IN [This will allow you to dub sound over sections of your original sound track].

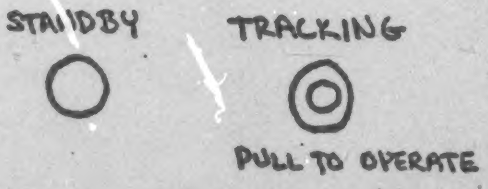
Adjust the appropriate audio channel control knob so that the needle oscillates within the left half of the black area and does not peak into the red area.


AUDIO MONITOR
PUSH ON
METER SELECT
VIDEO/ TRACKING
AUDIO CH1 CH2
VIDEO
MIN MAX
AUDIO CH1
MIN MAX
AUDIO CH2
MIN MAX

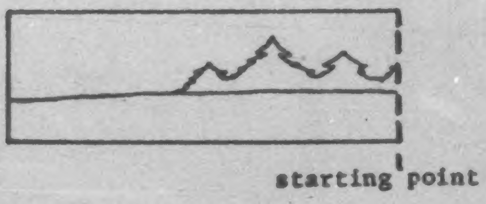
EDITING

[illegible]n you make your edit, it is important to have both VTRs running together [illegible] 0 seconds.

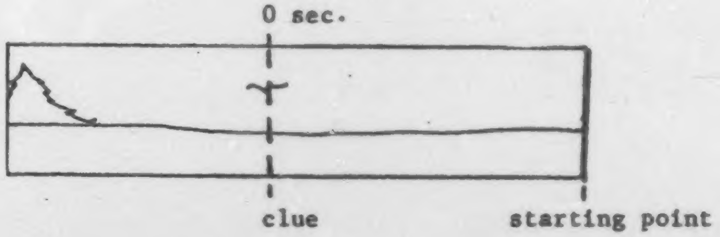
[If you use the STANDBY button on the 1" VTRs, this time can be shortened to 5 seconds. STANDBY starts the tapeheads going at full speed before you set the tape in the playback mode. Do not leave the VTR on STANDBY for long periods of time. This will avoid wearing down the tape in one place.]


STANDBY
TRACKING
PULL TO OPERATE

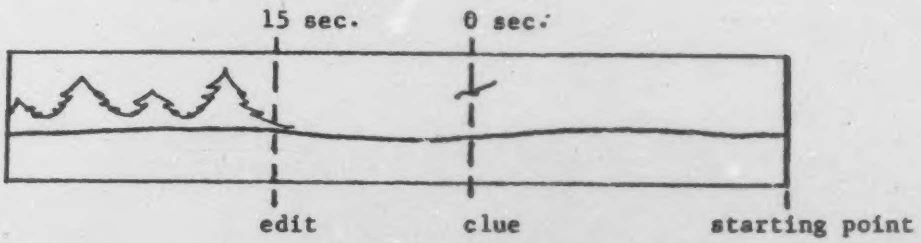
Rewind the PLAYBACK VTR to a section before the shot you want to add starts.


starting point

Start the VTR in the playback mode [PLAY/REC on the 1" VTRs, FORWARD on the AV-3650]. When the VTR is running at full speed, pick a clue -- either visible or audible -- that occurs before you want your shot to start. It may also help to set the counter to 000 for when you have to locate the shot for the edit.

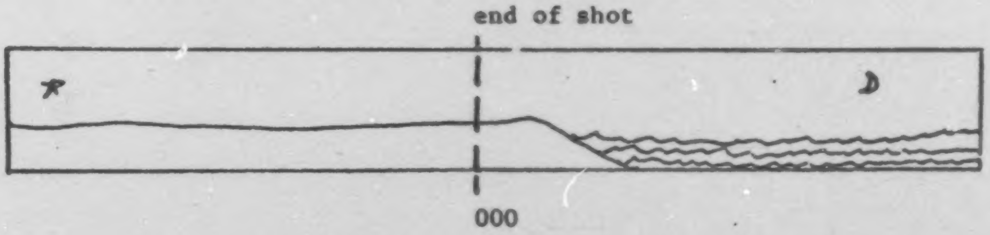


Start the stopwatch when your clue appears. In this case, a redwinged blackbird flies into the picture.

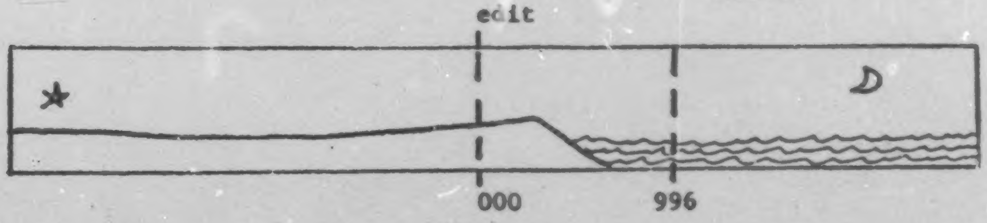


Stop the stopwatch when the beginning of your shot appears and note the time. It should be 11-20 seconds in length. For our example, we timed 15 seconds. Then rewind the tape to any point before the clue that insures that the VTR will be running full speed when the clue appears.

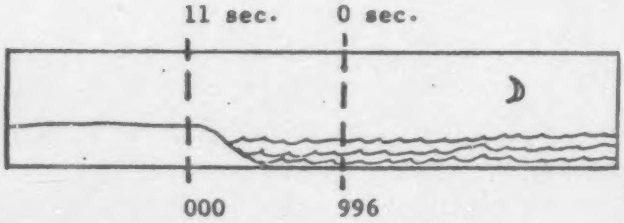
On the EDIT VTR, play the tape you wish to add your shot onto and, with the VTR running at full speed, set the counter to 000 at the point where the old shot ends and the new one starts.



Rewind the tape for a short length, stop it, and note the counter position exactly. For example $\boxed{996}$ is different from $\boxed{99^{6}_{7}}$.



Start the EDIT VTR from a completely stationary position and the stopwatch simultaneously. If you are using a 1" VTR, remember to turn on the STANDBY button.

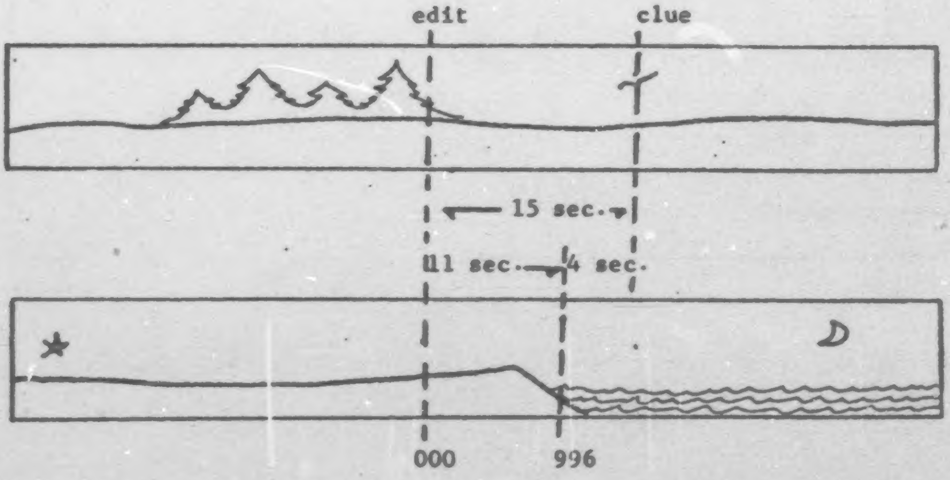


Stop the stopwatch when the end of the shot is reached -- 000 on the counter. For our example this time is 11 seconds. Then stop the tape and rewind to the exact counter position --i.e. 996.

NOTE: The time recorded for the EDIT VTR has to be less than the time recorded for the PLAYBACK VTR, but long enough for both VTRs to run together for 10 seconds.

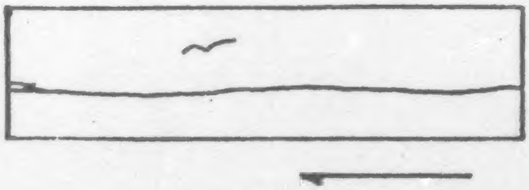
Subtract the time for the section on the EDIT VTR from the time for the section on the PLAYBACK VTR and note the difference.

15 seconds	PLAYBACK VTR	forest, time from clue, VTR at full speed
-11 seconds	EDIT VTR	seashore, time from counter, VTR initially stopped
4 seconds	difference	

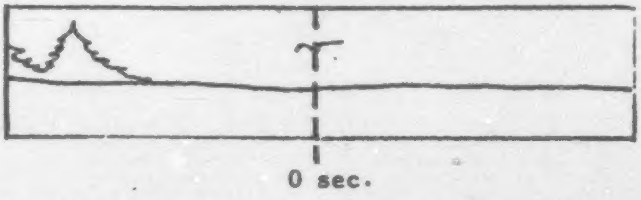


You are now ready to edit. Check the switches-- the audio level should be turned down and on the EV-320F, the EXTERNAL SYNC switch should be on NORMAL.

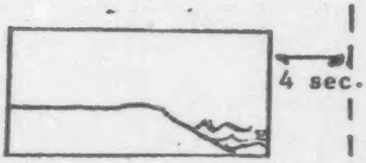
Start the PLAYBACK VTR.



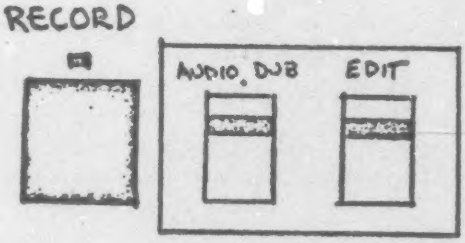
When the clue appears, start the stopwatch.



When the difference time has elapsed (4 seconds), start the EDIT VTR.

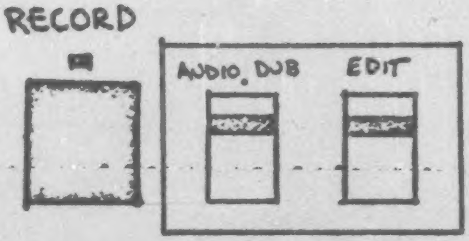


If you are using the AV-3650 as your EDIT VTR, press the EDIT button.

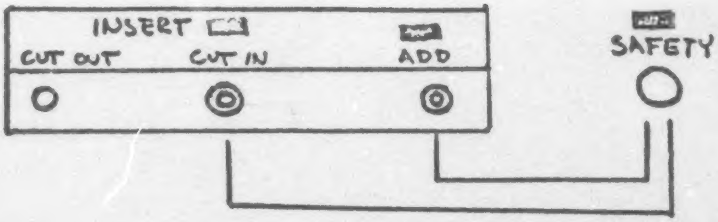


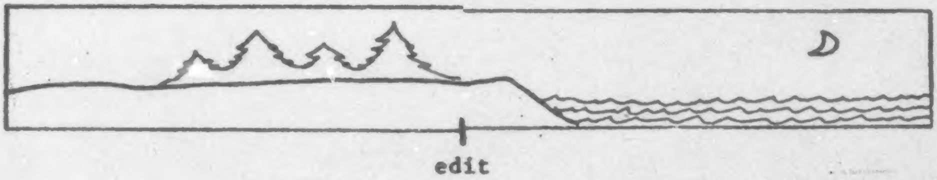
When the entire playback time has elapsed (in our example 15 seconds) press the appropriate button on the EDIT VTR.

On the AV-3650, press the RECORD BUTTON.



To edit on the EV-320F, press ADD and SAFETY simultaneously or press CUT IN and SAFETY simultaneously.

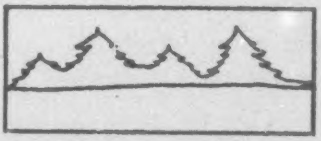




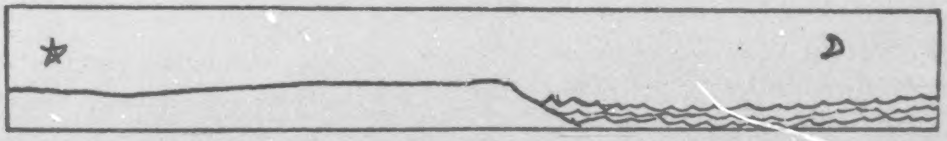
Record your shot for its entire length. Unless you want to use CUT OUT, let the EDIT VTR record at least 20 seconds beyond where you want your shot to end. This will allow you to get a clean edit for your next addition.

CUT OUT is used to insert a section within a shot already on the tape that is on the EDIT VTR. For example:

To insert this shot of the forest

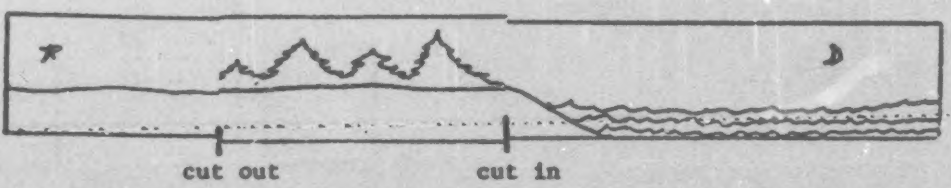


into this shot of the seashore --



follow your normal editing procedure.

Use CUT IN and SAFETY to start your shot of the forest. Press CUT OUT when you want the forest to end and the seashore to resume.



Stop both VTRs. Rewind your EDIT VTR to a point before the EDIT. On the EV-320F, flip the EXTERNAL SYNC switch to DEFEAT. Playback the tape to check the edit and your recording.

APPENDIX IX-E

Information on Videotape Projects

INFORMATION ON VIDEO TAPE PROJECTS

In order to evaluate use of the video equipment and to protect equipment, we are using the following system for video checkout.

1. Prior to signing out any equipment, a project proposal must be filled out and submitted to Carol Weinhaus, Room 205 Aiken Computation Lab. This proposal will later be used to evaluate the use of the equipment and help determine what additional equipment might be needed. Therefore, be as clear as possible with your objectives, your reasons for changes in your plans, and your difficulties with the equipment.

2. Each time you check out equipment, a sign out form must be filled out listing those pieces of equipment borrowed.

3. When you return the equipment, it must be checked over by a staff member. Otherwise you will be held responsible for damage discovered after you have checked in the equipment.

4. When you have finished your project, a completion statement is required along with a review by your advisor or two reviews from people agreed upon with your advisor.

IMPORTANT CONSIDERATIONS

1. Videotape equipment is extremely expensive. Although it is insured, the policy is deductible: If you lose or damage equipment while it is signed out to you, you will be held responsible for an appropriate amount up to the deductible ~~fee~~ coverage.

2. CAMBRIDGE IS NOT A SAFE PLACE in which to have expensive equipment. In the past, there have been a number of thefts of audio-visual equipment checked out by students. Therefore, it is not advisable to leave anything unattended. If you must leave equipment in your room or car, make sure it is out of sight and securely locked.

IX-E-2

PROJECT PROPOSAL

Name ______________________

Address ______________________

Telephone ______________________

Date ______________________

Continuing project ☐

Single use of equipment ☐

Course number ________ ☐

Independent Studies ☐

Individual use ☐

Division ☐

Other ☐ ______________

Title or subject of project ________________________________

Objective:

Planned Course of Action:

What is the anticipated audience (type and number)?

I understand that:

1. All TV material must carry a leading credit for equipment and facilities used.
2. When recording and/or transmitting, I must obtain clearance from the appropriate authorities in regard to places, material, and people.
3. If I lose or damage equipment while it is signed out to me, I will be held responsible for an appropriate amount up to the deductible portion of insurance coverage.

Signed by ____

Approval/signature of project advisor ______________________________

VIDEOTAPE PROJECT REVIEW FORM

Name of producer ______________________ Date ____________________

Project title or subject ________________

Reviewer ______________________________

Reviewer's principal field of interest ______________

____

The purpose of this review is to help evaluate how the TV medium has been used in this project. This documentation will help provide a realistic basis for future plans and budgets for TV use.

Please be as specific and candid as you can about the subject project.
Reviews should consider both -- technique and content
and should evaluate both -- apparent intentions and achieved results.

IX-E-4

COMPLETION STATEMENT

Name ______________________________

Date ______________________________

Approximate breakdown of time in hours.

Actual shooting _______________

Editing _________________________

Planning_________________________

BE BRIEF AND SPECIFIC:

What equipment did you use? What specific problems did you have with it?

Did you change your plans? If so, how?

Did you achieve you objective ?

Are you satisfied with your results?

Audience type and size.

Other comments:

TECHNICAL WARNINGS

NEVER POINT THE CAMERA AT THE SUN (or a reflection thereof or any source of bright light).
This means with the lens on, with the lens off, with the tape deck on, with the tape deck off --
IT BURNS PERMANENT SPOTS IN THE VIDICON TUBE (AT LEAST SIXTY DOLLARS TO REPLACE).

Avoil continuous shooting of a subject in strong light, especially when the picture has high contrast. If the camera is used for a long time in this way, the sensitivity of the vidicon tube will decrease or the vidicon may reatain the burned-in image.

Cameras should always have the lens cover on except when shooting.

Some video equipment has temperature limitations. Under no circumstances should equipment be stored in temperatures exceeding 140F as may be encountered in a closed automobile left parked in direct sunlight. Extreme cold may also cause the equipment not to function properly.

APPENDIX X

Videotape Users from Outside Project

Tony,

The following are the three case studies that you requested. I have also included Liss Jeffrey's present (but unfinished) course of action because I personally find it interesting. If you wish to use it instead of one of the others, I would suggest substituting it with Meltzoff since they tend to fall within the same range.

SHORT SUMMARIES OF THE PROJECTS

1. Paul Bamberg- This summer twelve of Bamberg's students made videotapes in groups of four. This took the place of two weeks of labs (two afternoons) although some spent more than the required time for normal labs. The tapes were then shown in class. and reviewed by fellow students. It is interesting to note how many of the reviews focus on technical difficulties (some of which are inherent when you edit in the camera) instead of the content or whether they learned anything from them.

Category: teaching and instruction in the classroom, student and professor use

2. Andrew Meltzoff- Last spring Meltzoff used videotape to record experiments of baby hiding patterns. These were later viewed to collect data for his senior thesis. After he collected his data he was able to reuse the tapes. He also edited parts of his data for viewing. (An interesting side note to this, is that he was unable to borrow the necessary equipment from a professor in his own department who had equipment).

Category: collecting and storing research data, part of thesis presentation, student use

3. Robert Gogel- Gogel's use differs from the above in that:
    1. It was a short term as opposed to long
    2. It was used for an extracurricular activity (a house play) instead of an academic application.

Gogel tape the Lowell House Opera and subsequently showed it to the actors. He later bought the tape.

Category: recording performance (the actors were able to see something they usually are unable to), student use

If you want an example of professor use or what I would call student artistic or expressive use let me know.

Carol

[illegible]

X-2
PROJECT PROPOSAL

Name Paul G. Bamberg
Address Jefferson 257a
Telephone 5-3298
Date Aug. 4, 1972

Continuing project ☑
Single use of equipment ☐

Course number Physics S-1 ☑
Independent Studies ☐
Individual use ☐
Division ☐
Other ☐ ____________

Title or subject of project Experimental Particle Physics

Objective: ~~Students will~~

To produce short videotape sequences of various aspects of elementary particle research at Harvard.

Planned Course of Action:

Students will learn to use the Portapak under the supervision of Afsaneh Najmabadi. They will visit the CEA, cyclotron, and bubble chamber, select subjects for videotaping, and prepare short video sequences which I will incorporate into a lecture.

What is the anticipated audience (type and number)?

110 Physics S-1 students

I understand that:

1. All TV material must carry a leading credit for equipment and facilities used.

2. When recording and/or transmitting, I must obtain clearance from the appropriate authorities in regard to places, material, and people.

3. If I lose or damage equipment while it is signed out to me, I will be held responsible for an appropriate amount up to the deductible portion of insurance coverage.

Signed by Paul G. Bamberg

Approval/signature of project advisor Paul G. Bamberg

VIDEOTAPE PROJECT REVIEW FORM

Name of producer Physics 5-1

Date 8/17/72

Project title or subject Cyclotron Bubble Chamber

Reviewer S. Fleet

Reviewer's principal field of interest

The purpose of this review is to help evaluate how the TV medium has been used in this project. This documentation will help provide a realistic basis for future plans and budgets for TV use.

Please be as specific and candid as you can about the subject project. Reviews should consider both -- technique and content and should evaluate both -- apparent intentions and achieved results.

Cyclotron — The purpose of the tape was to describe the cyclotron + detail its uses in physics + medical research. The presentation was a helpful supplement to the classroom material + filled in on some important matters. In addition, of course, the making of the tape was a learning experience for those involved in its production.

Bubble Chamber — Good analysis of reactions in a bubble chamber illustrated by computer readouts + schematic diagrams.

VIDEOTAPE PROJECT REVIEW FORM

Name of producer Physics S-1 Video Lab

Date 8-17-72

Project title or subject Cyclotron

Reviewer

Reviewer's principal field of interest Biology - environmental science

The purpose of this review is to help evaluate how the TV medium has been used in this project. This documentation will help provide a realistic basis for future plans and budgets for TV use.

Please be as specific and candid as you can about the subject project. Reviews should consider both -- technique and content and should evaluate both -- apparent intentions and achieved results.

Orchestrated like a suspense movie, as a counterpoint to the photographs - a sort of visual-aural pun. Highlights of aspects of cyclotron mechanism, and its uses, physical and medical, are covered. It even has a moral. Smoothness of photography - editing a little lacking, however the intended viewpoint of the cyclotron came across clearly.

VIDEOTAPE PROJECT REVIEW FORM

Name of producer
Date 8/17/72
Project title or subject Bubble Chamber
Reviewer B. GIMBEL
Reviewer's principal field of interest

The purpose of this review is to help evaluate how the TV medium has been used in this project. This documentation will help provide a realistic basis for future plans and budgets for TV use.

Please be as specific and candid as you can about the subject project. Reviews should consider both -- technique and content and should evaluate both -- apparent intentions and achieved results.

From the standpoint of content, the film was indeed infortive. It gave a brief explanation of what the bubble chamber was supposed to do. My only objection is that perhaps instead attempting to discuss so many concepts, that the number could have been decreased + more time spent on them. On the whole however the film was informative and serious in nature.

From the standpoint of technique; The opening scene was clever, + the example of the beer / bubbles was well done. The use of the charts + graphs etc, was also handled well.

I did however object to the overuse of fadeout, as it appeared as if all too often the scene faded out + another one was begun.

Finally - The film was for the most part serious in nature. It should have stayed that way. The ending, with the bubble blowing was unnecessary + out of place. It would have been more effective had the makers of the film either remained ~~+~~ completely serious, or added more humor throughout th piece.

VIDEOTAPE PROJECT REVIEW FORM

Name of producer Dave Johnson

Date

Project title or subject ~~Daphne goes to [illegible]~~

Reviewer [illegible]

Reviewer's principal field of interest food and Sleep!

The purpose of this review is to help evaluate how the TV medium has been used in this project. This documentation will help provide a realistic basis for future plans and budgets for TV use.

Please be as specific and candid as you can about the subject project.
Reviews should consider both -- technique and content
and should evaluate both -- apparent intentions and achieved results.

Shoddy Beginning - Low key, ~~[illegible]~~ boring, tiresomely didactic - Video used very unimaginatively by presenting a lecturer and blackboard. On top of that, it is impossible to see the blackboard clearly.

POOR

waste of video tap

airplane interference covered up the sound for about a minute or two. What is it about? No Title given. Only see the back of the lecturers head, for the most part. It's hard to believe that someone made this tape.

Poor sound because of background noise
Much too long: it should never have started.

VIDEOTAPE PROJECT REVIEW FORM

Name of producer ______

Date 8/17/72

Project title or subject Bubble Chamber

Reviewer Robert Barbieri

Reviewer's principal field of interest Physiological Psychology

The purpose of this review is to help evaluate how the TV medium has been used in this project. This documentation will help provide a realistic basis for future plans and budgets for TV use.

Please be as specific and candid as you can about the subject project. Reviews should consider both -- technique and content and should evaluate both -- apparent intentions and achieved results.

In part, the medium is the message. In contrast to the "cool" medium of lecturing, the videotape provides a welcome break and proves entertaining.

Although the process is a definite plus for the videotape, the content was only fair to mediocre. The theoretical content was certainly poor. The explanations were incomplete, and incoherent as a whole. The ~~[illegible]~~ importance of the examples given was never indicated. The single saving grace of the content was the opportunity to view a few of the instruments used in the study of elementary particles.

The mood of the entire clip was set by opening and closing "historical" ~~[illegible]~~ anecdote structures. To start, a facetious and unrewarding ~~[illegible]~~ indicated the importance of beer in the insight that led to the discovery of the bubble chamber. To end, a misplaced pun between children's bubbles and bubble chambers was perpetrated. These structures swamped the educational material.

Although the learning process can certainly be helped by entertaining material, the film seems to leave much of the education out.

VIDEOTAPE PROJECT REVIEW FORM

Name of producer ______

Date 8/15

Project title or subject cyclotron

Reviewer L. Golbe

Reviewer's principal field of interest biology

The purpose of this review is to help evaluate how the TV medium has been used in this project. This documentation will help provide a realistic basis for future plans and budgets for TV use.

Please be as specific and candid as you can about the subject project. Reviews should consider both -- techrique and content and should evaluate both -- apparent intentions and achieved results.

I have never seen the cyclotron, and I still don't think I could describe its appearance to someone any better than I could before I saw the tape. There just wasn't enough general orientation before zooming in on the specific components of the machine.

Narration was clearly written and spoken, but the music, I felt, was sort of a hodge-podge of styles - the Kubrick themes were a good idea - the Beatles had no place there.

Description of medical application was well-presented, though maybe the 1812 Overture would have been more appropriate than "Happiness is a Warm Gun".

VIDEOTAPE PROJECT REVIEW FORM

Name of producer —

Date 8/18/72

Project title or subject D. JOHNSON LECTURE

Reviewer B. GIMBEL

Reviewer's principal field of interest —

The purpose of this review is to help evaluate how the TV medium has been used in this project. This documentation will help provide a realistic basis for future plans and budgets for TV use.

Please be as specific and candid as you can about the subject project.
Reviews should consider both -- technique and content
and should evaluate both -- apparent intentions and achieved results.

All around this tape was poor. The first half was simply dull, perhaps moreso because I didn't know what was to follow (The showing of the beam apparatus etc.). The filming showed no originality as the camera was simply planted + started. No original techniques were demonstrated. The whole effort ~~was~~ could well have been a 1 man affair as the only person really seen was Johnson

The video tape program itself has merits. However tapes like this make one wonder if the purposes behind the program (developing techniques of taping etc.) were really accomplished.

VIDEOTAPE PROJECT REVIEW FORM

Name of producer The Electric Beam

Date

Project title or subject ~~[illegible]~~ ~~Daphne Dewdrop + SH#7~~

Reviewer

Reviewer's principal field of interest Psychology

The purpose of this review is to help evaluate how the TV medium has been used in this project. This documentation will help provide a realistic basis for future plans and budgets for TV use.

Please be as specific and candid as you can about the subject project. Reviews should consider both -- technique and content and should evaluate both -- apparent intentions and achieved results.

This was horrible! Film - even video tape - should not be so static. There were a total of 3 cuts during this film. The zooms were jumpy + constituted the only movement of the camera. I had thought we had progressed past a stationary camera.

Never moved camera, no cuts. Choppy Zoo

Daphne Dewdrop.

A tongue in cheek analysis of Revere Beach's entertainments. I was only disappointed that Daphne didn't appear, but I suppose one must dream.

VIDEOTAPE PROJECT REVIEW FORM

Name of producer ____________ Date 8/18

Project title or subject [redacted] Electron beam machine

Reviewer ____________ Reviewer's principal field of interest ____________

The purpose of this review is to help evaluate how the TV medium has been used in this project. This documentation will help provide a realistic basis for future plans and budgets for TV use.

Please be as specific and candid as you can about the subject project. Reviews should consider both -- technique and content and should evaluate both -- apparent intentions and achieved results.

Background noise - heavy
No title or introduction to give a clue as to
hat to expect.
not in continious focus
camera too far away to read the writing
on the board
No attempt to generate or arouse interest
i the subject.
Extremely unimaginative + boring presenta-
on -
Too long.
In the room w/ the apparatus + background
ise completely overwhelms speaker.

VIDEOTAPE PROJECT REVIEW FORM

Name of producer Physics S-1 Date 8/18/72

Project title or subject "Dave Johnson + Mollecular Beem"

Reviewer Jane Pincus Reviewer's principal field of interest film

The purpose of this review is to help evaluate how the TV medium has been used in this project. This documentation will help provide a realistic basis for future plans and budgets for TV use.

Please be as specific and candid as you can about the subject project.
Reviews should consider both -- technique and content
and should evaluate both -- apparent intentions and achieved results.

criticisms on style:
1. Slow-moving, therefore uncaptivating
2. improper use of the medium: TV has potential of increasing pacing, variations of approach to subject matter, decreasing "distance" between viewer & subject expressed, and thus increasing the effect on viewer.

criticisms on subject chosen + investigated:
none.
(excellent!)

The intention of the filmmakers could conceivably have been to record physics information. If so, that intention was achieved. ~~However~~, central shot (about... "Rule the world...") would be irrelevant.
The presence of that shot indicates perhaps a desire on the part of the filmmakers to be a bit more creative with the medium. That goal, has not been achieved, as discussed.

X-13

COMPLETION STATEMENT

Name Paul Bamberg

Date August 21, 1972

BE BRIEF AND SPECIFIC:

Approximate breakdown of time in hours.

Actual shooting 2-3 hrs

Editing none

Planning 15 hours

Dubbing sound tracks 8 hrs.

What equipment did you use? What specific problems did you have with it?

Portapak. No mechanical problems

Did you change your plans? If so, how?

No.

Did you achieve your objective ? Partially

Are you satisfied with your results?

Three of the four tapes which students made were satisfactory for showing at a lecture. One was not.

Audience type and size.

About 100 Physics S-1 students.

Other comments:

Lowell
[illegible]

X-14

PROJECT PROPOSAL

Name Robert Gogel

Address Mather 305

Telephone 8-7328

Date 3/17/72

Continuing project ☐

Single use of equipment ☑

Course number ☐

Independent Studies ☐

Individual use ☑

Division ☐

Other ☐

Title or subject of project Lowell House Opera

Objective:

view opera by Lowell House Opera Society - the opera is Ravel's L'enfant et Les Sortileges" - rarely ~~[illegible]~~ produced opera because of complex staging requirements.

Planned Course of Action

plan on taping opera - showing to the cast - and possible submission for Festival of Arts. (May, 1972)

What is the anticipated audience (type and number)?

members of opera production - ≈ 40

I understand that:

1. All TV material must carry a leading credit for equipment and facilities used.
2. When recording and/or transmitting, I must obtain clearance from the appropriate authorities in regard to places, material, and people.
3. If I lose or damage equipment while it is signed out to me, I will be held responsible for an appropriate amount up to the deductible portion of insurance coverage.

Signed by Robert Neil Gogel

Approval/signature of project advisor

X-15

VIDEO EQUIPMENT SIGN OUT

Please fill out the appropriate sections.

STUDIO USE:

Name __________

Date __________

Department __________

Hours spent using equipment __________

OUTSIDE USE:

Name Robert Gezel

Address Mather 305

Telephone 8-7328

Date 3/17

Time checked out 4:45pm

Time checked in 10, Mon., Mar 20 still has tapes.

7'H 6 5'H 48

+ +

Portapak (AV-3400), No. 1
- ☑ Camera
- ☑ Recorder
- ☑ Lens
- ☑ Power Adaptor
- ☑ Batteries, number 1

Portapak (AV-3400), No. 2
- ☐ Camera
- ☐ Recorder
- ☐ Lens
- ☐ Power Adaptor
- ☐ Batteries, number ____

1" Recorders
- ☐ EV-320F, Sony
- ☐ EV-310, Sony
- ☐ EV-200, Sony

1/2" Recorders
- ☐ AV-3650, No. 1
- ☐ AV-3650, No. 2

Monitors
- ☑ Sony, CVM110U, No. 1
- ☐ Sony, CVM110U, No. 2
- ☐ Sony, CVM110U, No. 3
- ☐ Conrac 14"
- ☐ Conrac 14"
- ☐ Conrac 25"
- ☐ Ball 10"

- ☐ Other __________

- ☐ Camera adaptor, Sony CMA-2
- ☐ Camera adaptor, Sony CMA-1

- ☐ Special Effects Generator (Gen-Lock)

Videotapes
- ☑ 1/2", 1/2 hour, number 3
- ☐ 1/2", 1 hour, number ____
- ☐ 1", 1 hour, Number ____

Microphones
- ☐ Lavalier, 649B, No. 1
- ☐ Lavalier, 649B, No. 2
- ☐ Omni-directional, 635A, No. 1
- ☐ Omni-directional, 635A, No. 2

- ☐ Audio mixer

- ☐ Bell and Howell Camera
- ☐ General Electric Camera
- ☐ AVC3000, Sony

- ☐ Shintron Video Pointer

- ☑ Cables (put down code numbers)
  Audio / Video 8 plug
  1' prong

- ☑ Tripod, No. 1
- ☐ Tripod No. 2

300

VIDEOTAPE PROJECT REVIEW FORM

Name of producer Bob Gogol

Date March 18, 1972

Project title or subject L'Enfant et les Sortileges (Lowell House Opera)

Reviewer Charles Fisher

Reviewer's principal field of interest In the chorus of the production

The purpose of this review is to help evaluate how the TV medium has been used in this project. This documentation will help provide a realistic basis for future plans and budgets for TV use.

Please be as specific and candid as you can about the subject project. Reviews should consider both -- technique and content and should evaluate both -- apparent intentions and achieved results.

The purpose of the project, I take it, was to get a clear, accurate tape of the opera. The cameraman had to work within certain limitations, which I had thought would be very obstructive: stationary location off to the side of the house, microphones on the camera, directly behind the percussion section. The final product was much better than what I had anticipated. The camera had been raised, and had a better view of the stage than any seat in the house. The picture was very clear, and most surprising, the audio was nearly excellent.

The main drawback was that the cameraman wasn't very familiar with the staging, thus causing him to miss several important entrances and actions, which he could have anticipated had he known the production better. He was making a good attempt to zoom in on soloists when there wasn't much action, to film the whole stage during the larger numbers, and generally to interpret the work through the filming, but he was limited by his unfamiliarity with the staging.

As a performer I greatly appreciated the chance to see from the "other side" the scenes in which I appeared ~~[illegible]~~. It was also the only way any of the performers ~~&~~ or musicians had of ~~the~~ seeing the entire piece as an artistic unit, unbroken by the necessity of having to ~~pla~~ interrupt one's concentration to actually perform part of it. As a member of the chorus, I had seen all of the non-chorus scenes many times before, sometimes from backstage, and earlier, from out front during the rehearsals. But that is considerably different from seeing the whole production develop from opening to closing curtain calls, as the spectators see it.

The cast saw the tape late at night before the day of the last performance, so there was no real attempt to use the tape as a tool for improving various features of the performance, but in other circumstances that is a very definite possibility for the use of such a tape. As it is, the fact that there is a record of this sort of something which has meant so much to me personally, is very gratifying. I hope I shall have a chance to see this tape again at least once, some months hence.

Charles Fisher

VIDEOTAPE PROJECT REVIEW FORM

Name of producer LOWELL HOUSE MUSICAL SOCIETY

Date 3/18/72

Project title or subject RAVEL: L'ENFANT ET LES SORTILÈGES

Reviewer PETER C. WYLDE

Reviewer's principal field of interest STAGE DIRECTOR

Peter C Wylde

The purpose of this review is to help evaluate how the TV medium has been used in this project. This documentation will help provide a realistic basis for future plans and budgets for TV use.

Please be as specific and candid as you can about the subject project.
Review should consider both -- technique and content
and should evaluate both -- apparent intentions and achieved results.

The videotape was made, apparently as a record of the above production and shown to the company immediately following the performance, with some question of a showing at the forthcoming Arts Festival. The sound, while scarcely hi-fi (the apparatus was seated squarely in the percussion section!) is surprisingly goo and considering it was the operator's second experience, the camera showed a fa instinct for picking up what was important in the stage action. Had the operator a a performance or two, and made at least a minimal plot, it might have been a very good film indeed. As it is, its principle benefit was in giving the performers an objective sense of the shape of the production and how they fit into it. This was particularly valuable in the case of the orchestra musicians, much occupied with instruments and scores, many of whom had had no ide of the stage action at all. Carefully planned and executed use of this medium could serve in future to give cohesion to the work of a performing company. Substantial portions of the opening of each scene were missed out, and, while the tape provided untold pleasure to the performers, it is scarcely of sufficien artistic or technical quality to be shown as entertainment or retained as a docum

Bob Gogel
3/21/72

used equipment:3/18/72

First of all, I'd like to thank Carol Weinhaus for arranging to get the equiptment for me on such short notice--I called 2:30pm on a Friday afternoon and had it by 5pm.

I discovered that:

1) Better location for the equipment might have been had if I had more time to plan--as it was, I got stuck behind percussion
2) Stage lighting is sufficient to tape, though some resolution is lost
3) Sound reproduction (balance of orchestra and singers) was quite good, using only mike on camera
4) Changing tapes at intermission took too long and I missed first part of 2nd act--rewinding of tape on to original reel took too long. I should have rewound after the opera
5) It would have helped if I had known plot of play--I found myself floundering every once in a while since I didn(t know who was saying what

The most rewarding experience was playing the tape back to the performers--they enjoyed it, and were disappointed that I had missed the beginning(because of low-lighting) and part of 2nd act. They were able to see themselves in perspective of whole production(there was alot of laughing!)

Robert Gogel

X-20

COMPLETION STATEMENT

Name Robert Gogol

Date 3/21

Approximate breakdown of time in hours.

Actual shooting __________

Editing __________

Planning __________

BE BRIEF AND SPECIFIC:

What equipment did you use? What specific problems did you have with it?

Monitor - ok
porta pak — record lever jammed when I first got it
camera - I was paranoid about the lights
tripod - ok

Did you change your plans? If so, how?

no

Did you achieve you objective ?

yes

Are you satisfied with your results?

Quite so

Audience type and size.

40 - performers, orchestras

Other comments:

X-21

PROJECT PROPOSAL

Name Liss Jeffrey

Address 3 Durham St Somerville

Telephone 623-4424.

Date Dec 1/72

Continuing project [✓]

Single use of equipment []

Course number NS130 []

Independent Studies []

Individual use []

Division []

Other [] ____________

Title or subject of project [illegible] Female backward patients at Met State Hospital out for a walk.

Objective: To videotape the women, including a friend who is the ward attendant; to give the patients a chance to see themselves on videotape; to shoot some more, depending on what they wish to do, with the women talking; to let them see this.

Planned Course of Action: I need to go out to the grounds of the hospital, with the monitor so that the group can view themselves and comment (on tape recorder). as a group.

What is the anticipated audience (type and number)? other ward attendants

I understand that:

1. All TV material must carry a leading credit for equipment and facilities used.
2. When recording and/or transmitting, I must obtain clearance from the appropriate authorities in regard to places, material, and people.
3. If I lose or damage equipment while it is signed out to me, I will be held responsible for an appropriate amount up to the deductible portion of insurance coverage.

Signed by M Elizabeth Jeffrey.

Approval/signature of project advisor ____________

X-22

COMPLETION STATEMENT

Name Liss Jeffrey

Date Dec 3/72.

Approximate breakdown of time in hours.

Actual shooting 20 minutes in an hour-long situation

Editing Projected to take 3 hours (includ sound dubs)

Planning Weeks.

BE BRIEF AND SPECIFIC:

What equipment did you use? What specific problems did you have with it?

Portapak #3, monitor. The batteries did not power the monitor after a full night of charging.

Did you change your plans? If so, how?

Lack of the monitor completely altered the project and served to reinforce my initial assumption, that unless the group could see itself, as a group, the level of interaction would be pretty superficial.

Did you achieve you objective ? No.

Are you satisfied with your results? No.

Audience type and size. The patients, for the most part, enjoyed it. The ward attendants learned a great deal about their own behaviour + the patients' behaviour. They also became enthused as to the possibility of a continuation of the project, ~~or at least~~ in an on the ward situation. They learned also (as did I) about the possibilities of television (videotape) in therapy.

Other comments:

This was a very exciting project, and should be repeated under better technical conditions.

BEST COPY AVAILABLE

VIDEOTAPE PROJECT REVIEW FORM

Name of producer Liss Jeffrey

Date Dec. 2/72

Project title or subject Met State patients

Reviewer Ness

Reviewer's principal field of interest Psychology.

The purpose of this review is to help evaluate how the TV medium has been used in this project. This documentation will help provide a realistic basis for future plans and budgets for TV use.

Please be as specific and candid as you can about the subject project. Reviews should consider both -- technique and content
and should evaluate both -- apparent intentions and achieved results.

The failure of the monitor defeated the intentions, yet also reaffirmed them. I very much want to explore the effects on chronic mental patients, and their attendants, of being able to see themselves and comment upon what they see. The tape situation, as it comes across on tape, of a group of mental patients out for a walk, stopping in the woods and "interacting" with the camera has an eerie quality to it. The Apathy, the dominant characteristic of the backward, characterized the situation. It seems to be a uniform response of people not engaged in a very involving situation, to arrange themselves as in an old-time photograph, for the camera. It was not completely possible to overcome this factor in the present project, partly due to a time limitation (It was cold.)

VIDEOTAPE PROJECT REVIEW FORM

Name of producer Liss Jeffrey
Date Dec. 2/72.
Project title or subject Met State Patients.
Reviewer Chester King
Reviewer's principal field of interest psychology

The purpose of this review is to help evaluate how the TV medium has been used in this project. This documentation will help provide a realistic basis for future plans and budgets for TV use.

Please be as specific and candid as you can about the subject project.
Reviews should consider both -- technique and content
and should evaluate both -- apparent intentions and achieved results.

Evaluation incomplete due to monitor failure. However, I was later astounded at the possibilities when I saw the tape rerun. Each person can see themselves with a clearer idea of how they are and see the group interacting so they can make comments from many different places, not just the one they were at in the moment. It would be ideal to use this equipment on a "back-ward" where people are very withdrawn and much new life could come from a heightened awareness of details-

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VIDEOTAPE PROJECT REVIEW FORM

Producer Susi Jeffrey
Project
Reviewer Laurie Oliver

Date Dec 3, 1972
Reviewer's Principle Field of Interest.
Psychology

I felt the tape really caught the isolation which is probably the primary characteristic of these people's world. Yet the possibilities of the medium become apparent in that the people are at times more able to relate to the camera itself, and to each other about how they appear to the camera, than they otherwise seem to relate to each other. If used on the ward, if used in a situation which was both a habitual setting but might also include some new input (eg unusual activity to engage in), seeing themselves on the monitor would provide an entirely new perspective — some distance on their own lives, yet through a medium with which they could continually interact and interact as a group, seeing themselves as a group, a social unit.

Technically I thought the scene toward the end was particularly effective, where the people close to the camera were looking off and speaking to those across the clearing. It captures their attempts to interact as a group, which contrasts sharply with the very individualized response most have to the camera, to being on film, or the refusal to interact at all.

X-26

PROJECT PROPOSAL

Psy.

Name ANDREW MELTZOFF

Address QUINCY HSE #625

Telephone 498-3156 354-0109 Wm. James. 868-1821

Date 3/22/72

Continuing project [✓] (twice or three

Single use of equipment. []

Course number ________ []

Independent Studies []

Individual use [✓]

Division []

Other [] ____________

Title or subject of project SENIOR THESIS

Objective:

TO EDIT 9 FULL TAPES OF EXPERIMENTS DOWN TO 2 OR 3 ESSENTIAL OR DEMONSTRATION TAPE SHOWING THE CRUCIAL EVENTS OF THE EXPERIMENT.

Planned Course of Action:

TO RUN TWO (OR POSSIBLY 3) EDITING SES

What is the anticipated audience (type and number)?

THE FINAL TAPES MAY BE USED AS DEMO TAPES FOR A "DEVELOPMENTAL PSYCHOLOGY LUNCH" AT HAR 30 peo

I understand that:

1. All TV material must carry a leading credit for equipment and facilities used.
2. When recording and/or transmitting, I must obtain clearance from the appropriate authorities in regard to places, material, and people.
3. If I lose or damage equipment while it is signed out to me, I will be held responsible for an appropriate amount up to the deductible portion of insurance coverage.

Signed by Andrew N. Meltzoff

Approval/signature of project advisor [redacted]

VIDEOTAPE PROJECT REVIEW FORM

Name of producer ANDY MELTZOFF Date JUNE 30TH

Project title or subject A PSYCHOLOGICAL EXPERIMENT WITH INFANTS

Reviewer M. KEITH MOORE

Reviewer's principal field of interest CHILD DEVELOPMENT

The purpose of this review is to help evaluate how the TV medium has been used in this project. This documentation will help provide a realistic basis for future plans and budgets for TV use.

Please be as specific and candid as you can about the subject project. Reviews should consider both -- technique and content and should evaluate both -- apparent intentions and achieved results.

The psychology experiment Andy carried out was sufficiently complicated that "live editing" could not be undertaken. Consequently, he video-taped almost twice as many hours of experimenting as were finally needed for coding. The edited tapes are now compact enough that stream-lined coding and viewing are possible -- minutes of taped but scientifically uninteresting data no longer need be viewed.

For Andy's purposes content was more important than technique and all the essential information seems to have been well preserved. The tape decks used for shooting and the one for editing were very compatible as very little quality was lost in the editing process. Overall, I am satisfied with the final product and believe the planned job was well executed.

I was pleased to discover that Harvard had video-tape lending facility + was very impressed with the operation Andy received throughout the project. The individuals running the facility were extremely sensitive to Andy's time pressures (he was completing his undergraduate thesis) and arranged time for instruction and use of the equipment at the first available opportunity. It is a most worthwhile service and run extremely well: I salute them for it.

X-28

COMPLETION STATEMENT

Name Andrew Meltzoff
Date June 29th, 1972

Approximate breakdown of time in hours.
Actual shooting –
Editing 15 + 31¼ + 22 hrs.
Planning 3

BE BRIEF AND SPECIFIC:

What equipment did you use? What specific problems did you have with it?

2 AV3650
2 MONITORS (11")
CONNECTING WIRES

NO PROBLEMS

Did you change your plans? If so, how?

I ACTUALLY EDITED MORES TAPES THAN I HAD ORIGINALLY PLANNED. I DID THIS BECAUSE THE EDITED TAPES WERE MUCH BETTER (FOR MY PURPOSES) THAN THE ORIGINALS, WHICH NECESSITAT "WASTED" VIEWING TIME EACH SHOWING.

Did you achieve you objective ?

YES.

Are you satisfied with your results?

ABSOLUTELY

Audience type and size.

1st AUDIENCE - 3 MEMBERS OF THESIS COMMITTEE.
2nd AUDIENCE - HOW USED TO INSTRUCT OTHERS ABOUT THIS AREA OF CHILD RESEARCH; HAVE SHOWN TAPES TO 5 OTHERS SINCE THESIS COMMITTEE, EXPECT TO SHOW THIS TAPE OR A SIMILAR ONE - STILL TO BE AND TO OTHERS.

Other comments:

↓

I SHOULD LIKE TO THANK BOB DESMAISONS FOR COMING IN TO WORK AT [redacted] UNGODLY HOURS SEVERAL TIMES, AND FOR GIVING PATIENT INSTRUCTION.

I THINK THE VIDEO-TAPE MACHINE LENDING SYSTEM IS AN EXTREMELY GOOD IDEA, FOR THE OBVIOUS REASON THAT MANY WHO CAN MAKE GOOD USE OF SUCH MACHINES DON'T HAVE GRANTS TO PURCHASE THEM. HARVARD SHOULD HAVE MORE FACILITIES LIKE THIS ONE AND SHOULD MANAGE THEM AS WELL AS CAROL WEINHAUS + BOB DESMAISON

APPENDIX XI

Institutionalization of Videotape Technology

APPENDIX XI-A

Letter from A. G. Oettinger to Dean Harvey Brooks

THE AIKEN COMPUTATION LABORATORY
DIVISION OF ENGINEERING AND APPLIED PHYSICS
HARVARD UNIVERSITY, CAMBRIDGE, MASSACHUSETTS 02138

29 September 1972

TO: Dean Harvey Brooks

cc: Dr. P. S. McKinney
Mr. Joe Wyatt

Dear Harvey,

This is to bring you up to date on the status of our video facilities and to suggest that the matter might be brought to the attention of the Council of Deans.

The time is drawing near when both the money and the justification for treating the facility as an experimental one, primarily paid for out of my research grants and otherwise supported by the Division through the use of equipment acquired through the Tozier Fund, etc., are running out. Some alternative provisionfor the future has to be made.

Attachment 1 outlines the basics of the current financial commitment to the facility. Our investment in equipment to date totals somewhere between 40-50 thousand dollars. The uncertainty stems from the fact that some of the equipment occasionally in our custody is owned by the Physics Department and some by the Office of Information Technology.

The breakdown of the $13,000 out-of-pocket expenses in the six month period from March 1 to September 1, 1972 is self explanatory. Do note, however, that it does not take into account space and other miscellaneous background costs.

Since late February of this year, my staff in cooperation with the Division Accounting Office has kept track of the usage of time and resources as if we were billing to specific projects, although no actual bills were ever sent out. The tabulations in Attachments 2 and 3 summarize the resulting information.

You will note, in Attachment 2, that 35% of staff time was applied to projects outside the Division and, indeed, outside the Faculty of Arts and Sciences. Attachment 3 shows that 74% of the usage of equipment was by other departments. The sharp difference between these two figures results from the fact that we could be much more generous in letting others use equipment during otherwise idle periods than we could be in providing staff support that would have taken time away from our own demands beyond video work.

The foregoing is summarized in Attachment 4 which shows how the operating expenses listed in Attachment 1 would look prorated in several ways.

The first line of Attachment 4 breaks staff expenses down in accordance with the percentages of Attachment 2. The second line breaks equipment usage expenses down in accordance with the percentages of Attachment 3 while the third line combines both of these.

The fourth line shows that in actuality 90 percent of the expenses were charged to my research projects and ten percent to Division accounts. As previously mentioned, no charges were made to outside users. The growth in amount and diversity of outside use, is, I think, a significant phenomenon underlined by the fact that close to 200 students signed up this week for Natural Sciences 130 "Communication in Societies" for the 75-80 openings that we can handle. Last year the sign-up rate was nearly as high and we were able to admit 100 since I was able to pull together a slightly larger staff.

As my grant money for these purposes runs out during the coming year, we need to find alternative ways of financing the video facility or else to drop it.

You are aware that throughout this past year our staff has collaborated with the Office of Information Technology, the staff in the President's office and the committee responsible for planning for the science instruction development laboratory in the Science Center. We believe that much is to be gained by providing facilities of this type to as wide a segment of the University's students and faculty as possible.

We were therefore pleased by OIT's offer to cooperate in the management and financing of the facility during this academic year. The details of the arrangement worked out through a series of meetings earlier this month are, as I understand, being given to you by Peter McKinney in a separate letter.

If policy on these matters is to be made without repeating some of our past errors in the computer area and in the telecommunications area, I think it would be appropriate for the Council of Deans to take notice of these developments at this time so that developments in future years might benefit from broad guidance.

Having just received and accepted Derek Bok's invitation to serve on his new University-wide committee considering the uses of technology in the teaching programs of the University, I am aware that issues of this type may well fall under the purview of that committee. However, I think that we are faced here with questions of short and intermediate range operating policy which need earlier attention than I imagine even the hardest working committee could provide or, in any case, act upon.

I should therefore appreciate your calling this material to the Council's attention and I look forward to further guidance from you.

Sincerely yours,

Anthony G. Oettinger

AGO:cmb

attachments

Attachment 1

Estimated 6-month Budget for Video Facility

3/1/72 - 9/1/72

Salaries (including fringe benefits)		7350
Tapes and Supplies		
(10) 1/2" - 1/2 hr.	$140	
(10) 1/2" - 1 hr.	240	
(10) 1" - 1 hr.	450	
		1000
Equipment Repair (Cramer, Son[illegible] etc.)		500
Equipment Insurance		250
Miscellaneous (tel.,xerox,postage)		150
		$9250
41% Overhead ⟶		3800
		$13,050
Capital Equipment Total ⟶		$44,000

Attachment 2 XI-A-5

Sept. 7, 1972

STAFF TIME

02/27/72 to 08/27/72

	DIVISION	TOTAL HOURS	% of TIME	
%. —	DIVISION			
	PAO 102	1	---	
	NS 111	1	---	
	7069 DOT	2	---	
	9015 Bell Lab.	20	2%	
	Bossert Colloquium	2-1/2	---	
	Haig/Bossert	1	---	
	Standish	26-1/4	2%	4%
% —	DIVISION PROF OETTINGER			
	AM 271/ NS 130	146-1/4	13%	
	NS 131	21-1/2	2%	
	Ruth Davis Lecture	8	1%	
	Mitre Corporation	4	---	
	Oettinger Colloquium	31-1/4	3%	
	Telecommunications Conference	162-1/2	15%	34%
5% —	OTHER DEPARTMENTS			
	Business Schools	2	---	
	Graduate School of Design	5-1/4	1%	
	School of Education Lecture	9-3/4	1%	
	Festival of the Arts	25-1/4	2%	
	Fine Arts	2-1/2	---	
	H. C. O. Astronomy	1-1/4	---	
	Lowell House Opera	1/2	---	
	Math Department	4	---	
	Middle School	3	---	
	O. I. T.	12-3/4	1%	
	Physics Department	15-1/4	1%	
	President's Office	32	3%	
	Psychology Department	7-1/2	1%	
	Sid Lab.	125	11%	
	Social Science	3-3/4	---	
	Unitel	1/4	---	21%
PRO-RATED	ADMINSTRATION	353-1/4	32%	Prorate among others
	REPAIR	99-1/2	9%	
0%	GRAND TOTAL	1130	100%	

XI-A-6

Attachment 3

Sept. 7, 1972

VIDEO EQUIPMENT USAGE

02/27/72 to 08/27/72

	TOTAL HOURS	% OF USE	
5% - **DIVISION:**			
AM 115	16-1/2	---	
PAO 102	95	2%	
NS 111	2	---	
7069 DOT	2	---	
Bossert Colloquium	3-1/2	---	
Haig/Bossert	75-1/4	2%	
Popek	1-1/2	---	
Standish	20	1%	5%
21% - **DIVISION PROF OETTINGER**			
AM 271/NS 130	315-1/4	8%	
NS 131	188	5%	
Ruth Davis Lecture	3	---	
Independent Studies	151-1/4	4%	
Mitre Corporation	2-1/2	---	
Oettinger Colloquium	9-1/4	---	
Telecommunications Conference	168	4%	21%
74% **OTHER DEPARTMENTS**			
Business School	137	3%	
Carpenter Center	576-1/2	14%	
Graduate School of Design	840-1/2	20%	
School of Education Lecture	3	---	
Festival of the Arts	203-1/4	5%	
Fine Arts	21-1/2	1%	
H. C. O. Astronomy	225-1/2	5%	
Law School	8	---	
Lowell House Opera	65-1/4	2%	
M. I. T.	15-1/2	---	
Math Department	2	---	
Middle School	3	---	
O. I. T.	409-1/2	10%	
Physics Department S-1	105-3/4	3%	
President's Office	145	3%	
Psychology Department	81-3/4	2%	
Social Relations	151-1/2	4%	
Social Science	89-1/2	2%	
Unitel	1-1/4	---	
MAINTENANCE	11-1/2	---	74%
GRAND TOTAL	4149-3/4	100%	

Attachment 4

Video Facility Expenses

6-month period 3/1/72 - 9/1/72

	Prof. Oettinger	DEAP (excl. Oettinger)	University (excl. Oettinger & DEAP)	Total
staff expenses	$6,015 (58%)	$726 (7%)	$3,629 (35%)	$10,370
equipment usage expenses	$563 (21%)	$134 (5%)	$1,983 (74%)	$2,680
Total expenses	$6,578 (58%)	$860 (7%)	$5,612 (43%)	$13,050
Actual charges made	$11,800 (90%)	$1,250 (10%)	0	$13,050

Estimated 5-month Budget for Video Facility

9/1/72 - 2/1/73

Salaries (including fringe benefits)		$11,780
Tapes and Supplies		800
Equipment Repair (Cramer, Sony, etc.)		600
Equipment Insurance		200
Miscellaneous (tel., xerox, postage)		100
		$13,480
	41% Overhead (on $7342)	3,010
		$16,490

XI-A-9

Mar. 26, 1973

EQUIPMENT

09/01/72 to 01/31/73

IVISION	TOTAL HOURS	% OF TIME	
ES 145	2	---	
NS 110	9	---	
Analog Computer	17	---	
Audio Visual	7-1/2	---	
Bartee	3	---	
Bossert	42	1%	
C.R.C.T.	1	---	
C.R.R.	1	---	
Haig/Bossert	41	1%	
Kac Lecture	7-1/2	---	
Mis. Grad. Students	72	1%	5%
IVISION PROF. OETTINGER			
B.B.N. Conference	153-1/2	2%	
N.S. 130	5262-3/4	78%	
Phister Lecture	6-1/2	---	
Program on Information Tech. & Public Policy	37	1%	79%
Summer Institute	13	---	
THER DEPARTMENTS			
Biochemistry	-3/4	---	
Carpenter Center	25	---	
Chemistry Dept.	224	3%	
Graduate School of Design	180-1/4	3%	
School of Education	62-1/2	1%	
Elliot House	22-3/4	---	
Harvard Bulletin	3	---	
Harvard University Press	15	---	
Kennedy Institute	21-3/4	---	16%
Law School	4	---	
M.I.T. Cable T.V. Seminar	2	---	
Math Dept.	1-1/4	---	
O.I.T.	37	1%	
Physics Dept.	3	---	
Radcliffe	23	---	
Unitel	461-1/4	8%	
GRAND TOTAL	6762-1/4	100%	

XI-A-10

Mar. 26, 1973

TIME

09/01/72 to 01/31/73

		TOTAL HOURS		X OF TIME
	DIVISION			
20%	Audio Visual	1-1/2		—
	C.R.R.	15		4
	Kac Lecture	4		1
	Misc. Grad. Students	13-1/2	18%	3
	DIVISION PROF. OETTINGER			
57%	B.B.N. Conference	42-1/2		10
	N.S. 130	175-3/4		44
	Phister Lecture	4		1
	Program on Information Tech. & Public Policy	12	51%	3
	Summer Institute	13-1/2		3
	OTHER DEPARTMENTS			
23%	Chemistry Dept	46		12
	School of Education	2		—
	Harvard Bulletin	4		
	Harvard University Press	10		
	Law School	4-1/2	2%	
	M.I.T. Cable T.V. Seminar	1		
	O.I.T.	8-1/2		
	Physics Dept.	8-1/2		
	Radcliffe	1		
	ADMINISTRATION	39		1
	GRAND TOTAL	408-1/4		10

PRO-RATED 100%

Video Facility Expenses

5-month period - 9/1/72 - 2/1/73

	Prof. Oettinger	DEAP (excluding Oettinger)	University (excluding Oettinger & DEAP)	Total
staff expenses	$8080 (57%)	$2835 (20%)	$3260 (23%)	$14,175
equipment expenses	$1829 (79%)	$116 (5%)	$370 (16%)	$2,315
Total expenses	$9909 (60%)	$2951 (18%)	$3630 (22%)	$16,490
Actual charges	$10,352 (63%)	$3169 (19%)	$2969 (18%)	$16,490

APPENDIX XI-B

Excerpts from

OIT Newsletter

Harvard University Gazette

XI-B-1

O. I. T. NEWSLETTER

Office for Information Technology
Harvard University

1730 Cambridge Street
Cambridge, Massachusetts 02138

DECEMBER 1972

COMPOSITE ISSUE

run from December 1, 1972, to March, 73, approximately, with the set-up costs ing borne jointly by CRCT and OIT. Users ll pay the service rates charged by the st computer being used.

AP VIDEO SERVICES CENTER

e Office for Information Technology is pporting, in part, the DEAP Video Serces Center located in Cruft Lab. 111. is facility provides basic production sistance for ½" and 1" television proction, assistance in editing TV tapes, d advice and information relating to the e of the Harvard Information Transfer stem (HITS) to carry closed circuit telesion either within Harvard or interconcting to MIT. There are also available deo tape modules describing the editing ocess for instructional purposes. For rther information and assistance contact vid Cantor. 5-4376, or Bob DesMaisons, 4258.

RGER OF COMPTROLLER'S COMPUTING SERVICES

the spring of 1973, the Comptroller's fice will consolidate their computing

Professor Anthony G. Oettinger
Aiken Computation Lab 200
University Mail

counts on registration fees at conferences and symposia (such as the Annual ACM Conference, the Joint Computer Conferences, and Regional and Special Interest Group Symposia) and member discount prices on all publications listed in the ACM Publications Catalog.

HARVARD COMPUTING CENTER TECHNICAL MEMORANDA

#243	System Catalog
244	IBM Model 3420 Tape Drives
247	Account Security
248	Redefinition of RESTRICTED RESOURCE Service

IF YOU WOULD LIKE TO CONTINUE RECEIVING THE OIT NEWSLETTER...

...just call Gail Carroll, (49)5-4375 or Connie Towler (49)5-3389, or return the label from this copy to the Office for Information Technology.

DIRECTORY

Information.....Connie Towler, 5-3389/3223
Director.............Joe B. Wyatt, 5-4374
Assoc. Director.....John E. Austin, 5-4118
Asst. Dir. for Telecommunications..
Alfred A. Pandiscio, 5-2857
Accounts........Richard J. Stanton, 5-3528
Applications Development Group.....
Manager, David J. Farrell, 5-4501
Facilities.........Robert J. Burns, 5-3772
Harvard Computing Center...........
Manager, Guy J. Ciannavei, 5-3225
Program Library.................... 5-3767
User Assistance.................... 5-3242
Video Services........David Cantor, 5-4376

XI-B-2

O. I. T. NEWSLETTER

Office for Information Technology
Harvard University

1730 Cambridge Street
Cambridge, Massachusetts 02138

APRIL 1973

VIDEO AND TELECOMMUNICATIONS ISSUE

NEW VIDEO AND TELECOMMUNICATIONS SERVICES PROGRAM

During recent months, OIT has been developing, with the help of the members of the interfaculty Video and Telecommunications Working Group, a plan for a Video Services Center t provide equipment and personnel for televising classes, lectures and conferences, making video tapes and video cassettes, and providing video viewing and editing capabilities to th University. Building on the resources of the Division of Engineering and Applied Physics, this Center is operating in Cruft 111-112 and is available now for video production service Equipment includes black/white and color cameras, 1/2 inch Sony Port-a-pak tape units, 3/4 inch color video cassette recorder and playback units, 1 inch black and white recorder unit mixing and editing equipment, and monitors. Services can be used in the Cruft Center or elsewhere, and production assistance as well as equipment rental is priced at cost. General consultation and technical advice are available without charge. Those who are in the explo atory stages of a video or telecommunications proposal or who are considering the acquisition of video equipment are urged to call Dr. Alfred Pandiscio (5-2857), the Assistant Director for Telecommunications and the University's resident expert in this field. For Video Services, call OIT or the Audiovisual Center in your Faculty (see list on the opposite side Any of these Centers will direct you to the best place for the kind of service you need.

THE AUDIOVISUAL GROUP

The several existing centers providing video services will work closely with the OIT Center on a consortium basis so that each can extend the capabilities of the other and provide back-up for large productions. The OIT Center will be operated on a fee basis, whereas most of the faculty centers are operated as part of faculty and departmental budgets. The Working Group consists of twenty-two audiovisual professionals and faculty members using video and acts as an advisory and coordinating body under the aegis of OIT. The Group meets monthly in the OIT Conference Room and anyone with an interest in video projects or services is welcome. Meeting times vary and can be obtained from Mrs. Towler (5-3389).

HITS AND OTHER TELECOMMUNICATIONS SYSTEMS

The Harvard Information Transfer System (HITS), a closed-circuit television syste operating between WGBH and the North Yard area providing over twenty Harvard sites with multiple channels of audio and video is another OIT managed resource. The rang of HITS was extended last year with the a dition of a microwave link to MIT's Infor mation Processing Center where distribution goes into Buildings 9 and 10. Conve nient video origination and reception mod ules have been developed by the UNITEL Corporation for both ends of this link. OIT is working closely with MIT's Center for Advanced Engineering Studies in makin future video plans. All of the telecommu nications facilities are available for ed ucational and research use to members of the faculty.

IDEO CONFERENCE ROOMS - a selection

Occasionally there is a need to schedule a lecture, seminar or conference in a space hat lends itself to video taping or televising over the HITS and MIT links. The following reas have been used successfully for that purpose.

rts & Sciences:

Aiken 3 (8-12 seats, HITS, MIT)
Aiken 241 (15-25 seats, HITS, MIT, monitors)
Aiken Lecture Room (64 seats, HITS, MIT)
Boylston Auditorium (150 seats)
Carpenter Center Lecture Room (175 seats, HITS)
Emerson 105 (340 seats)
Emerson 210 (230 seats)
Harvard Hall 104 (140 seats, HITS, monitors)
Mallinckrodt MB8 (100 seats, linked to MB9, MB23)
Mallinckrodt MB9 (500 seats, linked to MB8, MB23)
Mallinckrodt MB23 (300 seats, linked to MB8, MB9, HITS)
Pierce 110 (207 seats, HITS, monitors)

siness:

Aldrich 12 (75 seats, HITS, monitors)
Aldrich 107 (90 seats)
Aldrich 207 (90 seats)

Design:

Piper Auditorium, Gund Hall (125 seats)

Dental Medicine:

Room 118 (studio, grid lights, control room)

Education:

Gutman Studio (50 seats, rear projection, HITS)
Larsen G-08 (50 seats, HITS, monitors)
Longfellow 100 (250 seats)

Radcliffe:

Hilles Auditorium (120 seats)
Hilles Penthouse (150-200 seats)

DIRECTORY

nformation.....Connie Towler, 5-3389/3223
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ssoc. Director.....John E. Austin, 5-4118
sst. Dir. for Telecommunications..
Alfred A. Pandiscio, 5-2857
pplications Development Group.....
Manager, David J. Farrell, 5-4501
acilities.........Robert J. Burns, 5-3772
arvard Computing Center...........
Manager, Guy J. Ciannavei, 5-3225

VIDEO SERVICES

Appropriate people to contact for general video services are:

-Business School:
Division of Audio-Visual Education
Director - Sam Zanghi.........495-6404

-Dental Medicine:
Department of Educational Research in Dentistry
Director - Gerry Kress........734-3300 X2328

-Education:
Gutman Library - Media Division
Director - Joe Blatt..........495-4228

-Public Health:
Office for Instructional Development
Acting Director - Constance West......
734-3300, X2151

-Office for Information Technology:
Assistant Director for Telecommunications - Al Pandiscio...........495-2857
Video Operations - Bob DesMaisons......
495-4258, 495-7598

Harvard University Gazette

April 20, 1973
Volume LXVIII, No. 30

Daniel Webster Memorial Hall

Video Services Center Opens

The Office for Information Technology has established a Video Services Center in order to provide university-wide coordination of videotaping activity.

The new center, located in Cruft Lab 111-112, will be able to provide video services to those areas of the university which have yet to invest time, people, or equipment in videotaping. In addition, the center will serve to extend the video capabilities of those faculties within the university who have already developed their own video resources.

The center's available equipment includes three portable camera-recorder

(Continued on page 2)

Video Services

(Continued from page 1)

packages, several black and white movable floor cameras, four half-inch recording decks, three one-inch recorders, color camera, color cassette recorder and playback units, special effects generator, monitors, and audio mixers. In short, the center is capable of multiple camera productions with switching, fading, and split screen operations on both the one-half inch or one inch videotaping level.

Already the staff activities have included the videotaping of demonstration trials for the Law School, providing equipment for researchers at the School of Education in a project where Jamaican children are studied as they watch "Sesame Street," preparing a documentary videotape outlining the business aspects of the University Press, and providing equipment and training for student video projects such as Physics 1 report, "The Physical Properties of the Frisbee."

While a rate structure has been established for equipment usage, Bob DesMaisons, in charge of the center's operations, says that "the rates will be low enough so as to encourage people to use video, not turn them away."

The center is able to help video projects in any way - equipment, operators, consultation, editing, training, and equipment maintenance. All inquiries related to video applications will be welcomed at the center and may be directed to Bob DesMaisons at 495-7598 or 495-4258.

APPENDIX XI-C

"The Electronic Classroom"

Harvard Bulletin, January 1973

The electronic classroom

A progress report on new educational technology at Harvard. Is it sci-fi, or a powerful teaching tool?

by Devereux Clarke

The scene: A Harvard House.

7:59 a.m.: Wilby Sharp '84 slumbers . . .

8 a.m.: Sharp's favorite passage from Johannes Ockeghem fills the room, brought there by prearrangement via HITS. Harvard Information Transfer System links Sharp's room to thousands of others in the University and to the Students' Computer Service. Stirred by the old master's quickening tempi, Sharp wakes. He pulls himself together in time-honored ways.

9 a.m.: A traditionalist, Sharp gets the *Crimson*. But not the *Crimson* that was delivered to one's door by hand unless rain, sleet, fog, or some eager nonsubscriber prevented its delivery. Seated at his desk *cum* teletype-TV terminal, he punches out a code for *Crimson* sports, weather, and events of the day (he doesn't care about film reviews or editorials). A minute later the first headline is typed across his screen: "Crimson Beats Yale, 23-2."

9:03 a.m.: Done with the *Crimson*, Sharp addresses himself to academic work. He punches buttons, and his screen fills with a videotape of a lecture he missed (for unacceptable reasons, but no matter) the evening before. Sharp is due to discuss the lecture at 11 a.m. with his tutor, a professor in the School of Public Health. He watches the lecture and makes notes on a piece of yellow, ruled paper with a No. 2 lead pencil. He uses his Fast-Fact Index to retrieve significant population statistics on the Kwakiutl Indians of the Northwest coast of the United States (Sharp, be it remembered, is studying anthropology and public health, a concentration of his own devising). At 11, he and his tutor, being equally unwilling to cross the Charles River by an antiquated public transit system, confer via cable TV. The tutor tries a little harder to communicate with his pupil than he might have done some years before, because he feels the depersonalization of TV. Sharp is, perhaps, a little less polite than his father might have been.

Noon: The morning's work completed, Sharp devotes his attention to his stomach. Lowell House food is an abomination, and so Sharp tries Adams House. He punches the Food Services code on his computer to get a menu. His worst fears materialize onscreen: steamed hamburgers or Waldorf salad. Technology has flowered. But the message, for twenty years, has stayed the same.

If all that were needed was technical savvy, Harvard could wire itself for Wilby Sharp right now. The unfolding of events could be transmitted live via cable to audiences theoretically of limitless size, or could be stored on tape for eventual viewing by our grandchildren. Through a videotaped lecture series, countless people on different occasions could hear a prominent professor teach, without making countless and recurring demands on his time. A metropolitan university without walls – merging the resources of Harvard and M.I.T. and Boston's other colleges and universities – could offer numberless students the chance to cross-register at will. All the facts in all the books in all the branches of the Harvard College Library could be stored on tape, easily retrievable by any child of our new age. And so on.

All of these things are technically possible. The question is, are they economically feasible or in any way desirable for Harvard? Will they ever be? Presi-

"The new technology," says William Bossert, Gordon McKay Professor of Applied Mathematics, "can change our rigid notion that a course is a discrete package delivered by a professor to a student. We'll begin to think in terms of modular course units, which students can tack together in creative ways to devise individual academic programs."

"There are groups of video people around the University who are effectively trying to re-invent the wheel," says Professor of Law Arthur R. Miller, LL.B. '58. "We have to build a capacity for pedagogical problem-solving given the new forms of technology."

dent Derek C. Bok is attempting to find answers to these questions.

Last January Bok called together an informal group to study telecommunications at Harvard. It was chaired by Stephen Farber, Assistant to the President; David Cantor, then Staff Assistant in the Office of the President, served as executive director. The group's task was to get talking philosophically and practically about instructional technology at Harvard, and to survey what actually was going on in that line, in a university where often the right hand and the left haven't been introduced.

How, the group asked itself, would telecommunications affect the character and programs of the University by 1980? The answer, they discovered, depends on what decision-makers think about three general propositions:

– the possibility of extending the impact of the University outside of its present sphere of influence through various information-transfer services, which would involve very close cooperation with other universities;

– the creation of a policy that would extract more good out of Harvard's own, existing information-transfer system (HITS), a policy that would touch on uses of the cable, criteria for access to it, implications for curriculum, and so on;

– the development of cable TV in general, particularly commercially in Cambridge.

The group found that the University's present technological resources are considerable, if scattered and unfocussed. Pockets of interest in telecommunications turned up all over – where one expected them (in the Division of Engineering and Applied Physics) and where one did not (in the Business School and the School of Dental Medicine). But the group discovered a lack of coordination in the acquisition and use of new equipment, a lack of systematic review of new opportunities for using such technology, and a lack of effort to exploit fully the facilities Harvard now possesses.

These discoveries suggested to President Bok the risk of waste and neglected opportunity, and he therefore appointed an official University-wide Committee on Education and Technology. It is chaired by William Bossert, Gordon McKay Professor of Applied Mathematics, and receives staff assistance from the Office for Information Technology. Sitting on the committee are Professors Gerald S. Lesser, Paul G. Bamberg Jr., James L. McKenney, Arthur R. Miller, and Anthony G. Oettinger; Drs. David G. Freiman and Ascher J. Segal; and Mr. Konrad Kalba.

"Technology," says chairman Bossert, "is not our problem. Our problem is what to do with technology Technology can help us break down the rigid structure of courses in our present curriculum. To a great extent, it's the curriculum that we need to grapple with in our committee meetings."

"The committee is trying to encourage promising, innovative projects in the use of new technology," says Farber. And, with President Bok's new $1.4 million Fund for Innovations in Teaching (BULLETIN, November, page 13) as inspiration, Harvard's faculty is perhaps less likely than it might have been to maintain a laissez-faire attitude toward the development of the electronic classroom.

The history of video at Harvard may be said to have begun in 1965 when David W. Bailey '21, then secretary to the Corporation, persuaded Harvard to install HITS. Few people in the University had any idea of how a cable system operated or for what purposes. As Anthony Oettinger, Professor of Linguistics and Gordon McKay Professor of Applied Mathematics, explains it, Bailey wanted to connect Harvard to WGBH, the educational radio and television station in Boston, to make events at Harvard like the Norton and Godkin Lectures open to more people than could fit into Sanders Theatre. He knew, moreover, that the cable would be a necessary resource of the future. But, says Oettinger, "Bailey was ahead of his time. It was a case of the classic struggle between a single vision at the top and a lack of grassroot support and awareness." Harvard got HITS, but HITS got ignored.

Today, most people at Harvard don't know that the University has a cable system. It escapes notice for several reasons. For one thing, the cable is highly invisible (it runs underground in the steam tunnels). For another, it is rarely used.

When people announce that video has come to Harvard, it isn't the cable they're talking about, it's video tape recording (VTR). It is not uncommon at all nowadays to see an undergraduate wandering around the Square with a video camera glued to his eye and a roving recorder or portapack slung across his shoulders. He's making the kind of movie that HITS could shoot around for showing in numerous Harvard buildings.

HITS has twelve channels per cable and two cables. They were laid down in the steam tunnels by New England Telephone, which won the bid for the installation contract and which now leases the system to Harvard for a monthly charge. The cables run from WGBH to Aldrich, Holyoke, Widener, Sanders Theatre, Memorial Church, Pierce Hall, Austin, Littauer, Sever, Strauss, Harvard Hall, Allston Burr, Longfellow, Larsen, Loeb, Lamont, Carpenter Center, Fogg. The possibility for wiring other buildings in close proximity clearly exists. The Science Center and Mallincrodkt Lab have just been wired; Gund Hall and Lehman Hall are next.

One cable, called the origination cable, takes signals from their point of origin to the head end or central switchboard, located in the TELCO room at WGBH. The signals are turned around and sent out along the second cable, known as the distribution cable. Each cable can handle twelve discrete programs, lectures, conversations, films, or any combination of communications simultaneously. One individual could talk with another via the cable; whole classrooms could tune into other whole classrooms to exchange questions and answers.

Furthermore, HITS need not be an isolated communications loop within Harvard. By means of a two-way microwave link, information originating at Harvard can be sent via cable to William James Hall, there to be sent over the air to Building 39 at M.I.T. From there the message can be sent to three M.I.T. buildings via their cable. It is really for this kind of exchange with other universities that HITS is intended. Yet there are no concrete plans for expanding the cable system to include other universities in the Boston area.

The way in which the system was installed made it "almost impossible for human use," says David Cantor, Assistant for Telecommunications in the Office for Information Technology. The cable ran into the basements of buildings as "black boxes," – that is, only a

Robert Saudek '32, Visiting Lecturer on Visual Studies, commutes to Cambridge from New York to teach a video course at the Carpenter Center. "Television," he says, "can corrupt as well as educate." A commercial television producer, he knows whereof he speaks.

XI-C-4

Seeing yourself as others see you may not be pleasant, but is usually instructive. Dr. Ascher Segall, Associate Professor of Epidemiology, runs a workshop at the School of Public Health for people who are learning to teach community medicine and public health. He uses a video camera to show them themselves in action.

tap or access point was provided. The idea was that the financial responsibility for locking into the system, wiring viewing rooms, and so forth, would be borne by the various departments occupying the several buildings. A nice idea, but it didn't work. In only four of the original seventeen buildings to which HITS ran, was HITS brought up from the basement. These are Sanders Theatre, Pierce Hall and the Aiken Computation Center, Harvard Hall, and Larsen Hall. By asking separate departments of the University to shoulder the financial burden of locking in to HITS, Harvard invited the establishment of separate spheres of technological influence and knowledge. The right hand began not knowing what the left was doing.

Not until President Bok's informal group began last winter's investigations did anyone realize what a lot of equipment was scattered around the University and what a lot of know-how existed. Some clusters of talent and resources were especially impressive. Nat. Sci. 130, for example, is an undergraduate course that brings together a large consortium of people using video to teach video. Called Communications in Society, the course is itself an experiment in communications through the use of various forms of educational technology. Extensive use is made of visual aids in the classroom, and, in addition, members of the class make debuts in required student projects as directors, cameramen, and actors and actresses.

Among other signs of interest in video at Harvard are these:

– Eric Martin, senior tutor in the Visual and Environmental Studies department, hopes to run a "mini Nat. Sci. 130" this spring. VES already offers a video course, given by Robert Saudek '32, Visiting Lecturer on Visual Studies.

– A Science Instructional Development (SID) laboratory has been proposed for the basement of the Science Center. Paul Bamberg, Associate Professor of Physics, has taken the initiative in this area. The SID lab would assist science faculty in the development and evaluation of new instructional techniques employing television.

– Faculty members, if they dare, may see themselves as others see them. The Office of Tests will videotape professors at work for those who wish to perfect their teaching techniques.

– The Division of Audio Visual Education at the Business School, with a collection of equipment unequalled except by Nat. Sci. 130, assists professors in

Konrad K. Kalba, Instructor in City Planning at the School of Design, will use a two-way video link with M.I.T. in his community planning course this spring, and he hopes to supplement his lectures with video tape recordings made in the field.

Gerald S. Lesser is chairman of the board of advisors of the Children's Television Workshop, producers of Sesame Street *and* The Electric Company. *Anyone with children who watch those programs has learned something about the pedagogical potential of television. Lesser, who is Bigelow Professor of Education and Development Psychology, is himself, professionally, most interested in using video to investigate how children learn, rather than to teach them things.*

film, slide, and tape presentations, and engages in a good deal of impressive research and development. Films and video tape are produced to supplement the School's case method of instruction. Young capitalists studying the decision-making process might, for example, watch a film debunking the myth that corporate decisions commonly are made in penthouse conference rooms, filled with well dressed M.B.A.s sipping cocktails around oak oval tables. Decisions in this film are made in a cubicle over salami sandwiches. The principal actor sounds off disparagingly about Harvard-trained businessmen. All very stimulating.

Quite clearly, someone needs to keep track of video services now offered at Harvard. Someone needs to be available to give students and professors reliable technical advice about video. Someone needs to maintain a decent quantity of video equipment. That someone is going to be the Office for Information Technology, the office now providing staff assistance to Mr. Bok's Committee on Education and Technology. With plans for a future Video Service Center, OIT is prepared to become Harvard's manager of electronic instructional technology – and so it may if the centralization of video services around OIT seems a good idea to those Harvard people who are now running separate systems.

And while the administrative problems presented by video at Harvard are being coped with well or badly, debate will continue about the pedagogical advantages of electronic technology. Surely, new technology must not be adopted merely because it exists. Some courses lend themselves easily to its successful use; others may not. Before one bursts one's buttons in praise of electronic teaching aids, one must believe that they will make students perform better or learn more easily, or that they will allow the presentation of material in better ways. One must believe that video in its full flowering will encourage students and professors to tap the resources of Harvard and the larger intellectual community more intensively and extensively. One must believe that the new technology will make possible a much wider range of communication between ourselves and our resources, and ourselves and ourselves.

Electronic instructional devices cannot compensate for a lack of vision in education policy. They are simply tools for skillful educators. But they are exciting tools, and Mr. Bok's new committee should not find its work in the least bit dull.

APPENDIX XI-D

Videotape Facilities in the Science Center

XI-D-1

THE AIKEN COMPUTATION LABORATORY
DIVISION OF ENGINEERING AND APPLIED PHYSICS
HARVARD UNIVERSITY, CAMBRIDGE, MASSACHUSETTS 02138

June 23, 1972

Memorandum to: Jack Austin, Paul Bamberg, Dave Cantor,
Tony Oettinger, Al Pandiscio, and Bill Rice

From: Carol Weinhaus

Subject: Videotape facilities in the Science Center

file

The following is a report on the various interviews I had with members of the faculty and staff who were either in departments which are to be in the Science Center or who are involved with videotape operations in the University.

With the faculty members who were either directly involved with the Science Center, or whose departments would have classes and labs there, I discussed ways in which videotape might be used in teaching. I often went into a more detailed explaination of the equipment and its possible applications for those members who were interested. With the faculty and staff who are working with existing video facilities, I explained the current video operation at the Division of Engineering and Applied Physics, as well as the various possibilities under consideration for the Science Center. In these meetings, I stressed the fact that the information that I was gathering was for input into the planning of video facilities and that these facilities and the various ideas about their equipment, operation, and personnel were in no way final.

Although no meeting covered all the aspects of video in relation to the Science Center and the University at large, general interest in the development of several areas emerged.

Most of the faculty expressed an interest in cassettes and playback facilities. This includes space in the library and labs as well as a room to accomodate larger groups. The library facilities would, in addition to video playback stations, also provide for cataloguing and storage of videotapes.

Moreover, the faculty members that are in favor of video facilities from which faculty, teaching assistants, and/or students would have access to equipment, stressed the need for personnel who would be able to assist them in the use of the equipment and the development of their materials. Several members wanted enough portable equipment included in these facilities to enable them to do field work. Also some faculty members were interested in the use of computers and computer scopes in relation to video. A large number of the staff, particularly those in biology, would want color capability.

Most of the faculty in biology, chemistry, and health related areas were extremely interested in a link between Cambridge and the medical school, although ideas for its specific application varied.

A major concern of most of the faculty interviewed, was that of how the operation of video equipment would be financed.

On the following pages, brief summaries of the interviews are given, followed by an appendix.

SUMMARY OF THE INTERVIEWS

Dave Cantor President's Office May 31

Cantor requested my help in developing plans for video facilities in the Science Center. This would involve talking to members of the faculty who would be teaching there in order to decide what would be needed. He brought up the questions of economics, maintenance, and computer access in relation to videotape facilities. The possibility of a video link with the med school and MIT was also mentioned.

Dick Lozeau Science Center Construction May 31

I obtained blue prints for the basement of the Science Center from Lozeau and set up a time to talk with him about the physical outlay.

Paul Bamberg Physics May 31

Bamberg asked me to help in planning a proposal for video facilities for the S.I.D. Lab in the Science Center. He suggested various members of the faculty for me to talk to to prevent the development of facilities that the faculty either doesn't want or need.

Jack Austin O.I.T. June 1

I discussed the above interviews with Austin. He talked about the possibility of obtaining funds from outside sources.

Dick Lozeau Science Center Construction June 1

I talked about the physical outlay of the Science Center with Lozeau and found out which sections were at this time funded for completion. Most of the basement of the Science Center was not to be finished. One of the four lecture halls (lecture hall C, 350 seats) is slated for completion by the summer of '73. We talked about considerations for the lecture halls.[1] Minimally the lecture halls must be able to function as standard lecture halls. We also discussed the ability to hook up the Science Center to HITS (Harvard Information Transfer System).[2]

Garrett Birkhoff Pure and Applied Mathematics June 1

Birkhoff was interested in the idea of developing materials for teaching. He was primarily interested in using a Tektronics Computer Graphics Scope in conjunction with some method of recording these displays. He cited the need for a teaching assistant as well as personnel who understand the technical aspects involved in using the computer and/or video equipment to aid him in the development of these materials. He stressed the importance of not duplicating existing material. Birkhoff felt a need for cataloguing and playback stations interms of library services. If video facilities are to be installed, he is concerned as to how they would be financed.

Steve Benton Division of Engineering and Applied Physics June 2

I talked briefly about the ideas for the S.I.D. Lab with Benton while he was in my office on other business.

Joe Blatt Audio/Visual at the School of Education June 2

Blatt gave Jack Austin and myself a tour of the School of Education's facilities.[3] This tour brings up the question of what should be considered for provision, if any, for the more traditional audio/visual equipment.

Bill Bossert Division of Engineering and Applied Physics June 5

Bossert is interested in video facilities but feels that a big studio production set-up should be avoided. This would mean that equipment would be fairly easy to sign-out and that there would be at least two editing stations, each of which would include a Gen-Lock (special effects generator). He prefers 1/2" equipment because it is portable. We discussed what would be necessary to record a computer graphics image on videotape.[4] He is interested in library facilities which would include cataloguing, storage, and viewing stations for videotape. Bossert suggested that Alan Erickson (Weidner Library) be contacted for developing the library services. There would be a need for the staff in the S.I.D. Lab to keep the librarians informed of what is needed for library video facilities. By the fall of '73, Bossert would like to have a room set up as a viewing station in the Science Center. He is also interested in computer driven microfiche consoles in the library. Bossert pointed out the need for being able to make copies of cassettes.

Roger Thomas Geology June 5

If video facilities were to be set up, Thomas would want to have personnel who could help with the equipment and the making of tapes. In addition, he would want an extra teaching assistant to help with the production of teaching materials. We discussed the use of the portable units for field work both on the part of the staff and the students. Thomas expressed a need for magnification possibilities in the video equipment. He also wants permanent monitors in the lecture halls, because he feels that temporary moveable monitors distract the attention of the class. He is also concerned with having a good control panel in the lecture hall. He sees video as useful in looking at recent processes in geology.

Otto Solbrig Biology June 5

I talked to Solbrig on the phone. If video facilities are installed he would want personnel to teach techniques involved in using the equipment. He is also interested in playback facilities and library services.

Michael Gill Biology June 5

Gill is interested in the ability to make cassettes that the students could play back in the labs. He is currently using film loops because they are in color and are student-proof. He prefers film over videotape because film has better resolution. He would want at least four playback units in the labs. In regard to a link with the med school, Gill is very interested, especially in the aspect of transmitting seminars.

Brook Baker Biology June 5

Baker, who works with the labs for Bio 15, has a video system which shows a video image from a microscope. No one really knows how to run the equipment, so it isn't used much.[5]

Jacob Shapiro Environmental Sciences (Public Health) June5

Shapiro was very interested in a link between Cambridge and the med school. He was also interested in a live set-up between the lab and the lecture hall that would have two way interaction. We also discussed the use of live video in the classroom to demonstrate the use of an oscilliscope. Library services would be needed if video facilities are present.

Tim Standish — Division of Engineering and Applied Physics — June 6

Standish is interested in video facilities and would also like to see a PDP 11 computer in the basement. He is interested in the development of modular courses and self-paced learning using videotape cassettes but since he is leaving, he said that Bill Bossert and John Haig will be working on this, possibly in conjunction with Craig Fields. He expressed a need for library facilities with cassette playback stations, and feels that later there will be a need for color.

Craig Fields — Psychology — June 6

Fields is planning to bring video equipment to Africa and shooting 100 hours for student study of large animal behavior. He prefers to use video over super 8mm film.[6] He is interested in library and cassette playback facilities. We discussed the ability of the computer to edit videotape and Fields told me what he is interested in in the way of a computer.[7]

Owen Gingerich + his teaching assistant Mike Zeilick — Astronomy — June 6

Gingerich and particularly his assistant Zeilick appeared to be interested in student use of the videotape equipment. He discussed the possibility of recording visiting lecturers for playback in future years. Regarding library and playback facilities, Gingerich would want to be able to assign 100 students a particular tape and have the necessary set-up to enable the students to view the tapes within three to four days. (Note: This fits in the same category as Dave Dolphin's suggestion for the establishment of services that would enable scheduling of playbacks for groups in the evening.) Gingerich is also interested in taping through a telescope. He also mentioned the use of videotape to present supplementary material for his course, for example, using a videotape of Brecht's Galileo instead of having the students read it. He expressed an interest in having a link between the Science Center and the observatory.

Lynn Riddiford   Biology   June 7

Riddiford talked about her previous experiences with audio tape and film loops -- she was not at all pleased with film loops.[8] She is interested in cassette playback stations in both the library and labs. In the library she would also like to see stations where slides can be viewed. We discussed the video microscope system. Riddiford was enthusiastic about a link between Cambridge and the med school. She also would like to have monitors in the lecture halls.

Jim Butler   Division of Engineering and Applied Physics   June 7

Butler is interested in using the portapak for field work in Bermuda. I suggested that he talk to Al Pandiscio if he wanted to borrow one for this fall. He was interested in color.

Sam Zanghi   Audio/Visual at the Business School   June 8

I talked to Zanghi on the phone about the general ideas of the relation of videotape to the Science Center. Although the business school is not particularly interested in a link to the medical area, Zanghi is interested in a link with the Yard for the transmission of lectures, like the Dunham lectures.

Edward Purcell   Physics   June 8

Purcell was not interested in the use of video for field work and didn't think that there would be much use for it in Physics 12 other than using video to magnify small objects during live class presentations. He is more interested in the overhead projector which he feels is simple and direct. Purcell is not very interested in a link with the med school but he is interested in some scheme for repeating discussions.

Lawrence Bogorad Biology June 8

Bogorad was very interested in a link with the med school. Regarding this link he felt that the following should be considered:

1. Its use for seminars, visiting lecturers, etc.
2. It should be convenient.
3. There should be a room with the capacity of 200 for its termination. Perhaps one of the smaller lecture halls.

We also discussed the possibility of linking the biology labs to the Science Center since much of their work is the labs. He feels that if video is used, it is important to have color.

Charles Whitney Astronomy June 8

Whitney was interested in the establishment of video facilities in the Science Center. He wanted to know if there were introductory sessions for the faculty on use of the portapak and other equipment. In addition to wanting portable equipment for faculty field work, Whitney was interested in using vidoe to take shots through a telescope. He did not feel that a link between the observatory and the Science Center would be necessarily helpful. We discussed the idea of student use of the equipment.

Bill Rice Bio-Chemistry June 9

Rice is interested in facilities that are, at least initially, relatively small but high in quality. He feels that a link to the med school is an idea whose time has come. There are three levels of interaction that he feels the link should transmit:

1. Seminars and lectures between the Science Center, the med school,and MIT.
2. Courses (Rice suggested that I find out from Henry Meadows how much it costs to operate the bus.)
3. Small group research seminars and noon-time group seminars.

Rice stressed the idea of making the equipment and help from personnel easily available. Also that the link is done on a complementary basis with the med school. He brought up the question as to what extent the school of public health building might be used. In respect to equipment in the Science Center, Rice felt that there should not be too much that was buildt in. He also felt that for the first year, people would be more interested in traditional methods of teaching. We discussed ideas of linking video with a computer, free access, and the cabling of the houses.

Karl Strauch Physics June 9

I told Strauch about various possibilities of video tape use in the Science Center and about the videotape operation of the Division of Engineering and Applied Physics. He said that he would be interested in coming to meetings in which the possibilities of video facilities in the Science Center are discussed.

Len Nash Chemistry June 13

I talked to Nash on the phone. He said that several members of the chemistry department have used videotape and that his department will be buying cassette playback equipment, although he himself does not use videotape very heavily. He was interested in facilities that would allow playback and in the use of video to enlarge a small experiment for viewing. However, he felt that the chemistry department's needs were satisfied by thier own equipment. He is not particularly interested in a link between the Science Center and Mallinckrodt.

Edward Wilson Biology June 13

I talked to Wilson on the phone. He said that he didn't need to use video and wasn't particularly interested but to contact his assistant David Woodruff, who runs the labs for his course.

David Woodruff Biology June 13

Woodruff is interested in adapting the slide tape format (audio soundtrack plus still pictures) to video. I told him that this is possible with the current equipment. Woodruff would want at least 10 playback units for 250 students, and would like color capabilities, although this is not necessary. He felt that it would be better to videotape in advance as opposed to having a link between the biology labs and the Science Center. He would want a large screen for playback in tutorial meetings.

Bob Silvergleid Biology June 13

Silvergleid was present during part of my discussion with Woodruff. Silvergleid has use videotape in the field to collect research material on insects.[9]

Mike Zeilick   Astronomy   June 13

Zeilick came over to learn how to use the portapak. He is interested in having students in Natural Sciences 9 using a portapak.

Constance West   School of Public Health   June 14

West gave me a tour of the new School of Public Health building. They are geared for large scale production as opposed to facilities where individuals can produce their own material.

Gerry Kress   Dental School   June 14

Kress showed me the dentil school video operation.[10] He is basically working with faculty in preparing tapes for classes. Currently they are operating on a marginal basis.

Eric Martin   Visual and Environmental Studies   June 15

I explained the Division of Engineering and Applied Physics's video facilities and the application of video in Natural Sciences 130 to Martin. He will be teaching a course next spring in which he is interested in getting people in fields other than Visual Studies to use videotape. He said that his department will be purchasing new equipment.

Ronald Vanelli   Chemistry   June 16

Vanelli is interested in a link to the med school, but more in terms of research than instructional classes. He mentioned the use of videotape in his department, especially in reference to Chem 20.[11] If video is used to transmit a live seminar, Vanelli feels that it is important to have two-way communication. He is a bit skeptical about this use of a link, but feels that the services should be provided and then see if it's used. He is interested in cassette playback in the lab and in library stations. In addition, he expressed some interest in color capability but is not certain that this is important.

Frank Westheimer Chemistry June 16

Westheimer doesn't believe in setting up general video facilities but instead feels that there should be funding for specific projects of individaul faculty members. He said that the chemistry department wants to own its own equipment. He wants time to make teaching tapes, if the University would be willing to pay for this time. During our conversation, Westheimer stressed the need for feedback and evaluation of any educational method. He is interested in editing facilities.

Paul Doty Chemistry June 19

Doty feels that some type of video facilities and services for the Science Center are inevitable. He is interested in the cheapest means of taping a course and in playback facilities from a central source as opposed to cassette stations.

Dave Dolphin Chemistry June 20

Dolphin is interested in cassettes and color capibilities. He would like to see a large screen in the lecture hall for video playback. In addition to library services that include cassette stations, Dolphin would like to have services that would enable large groups to view a playback in the evening. In terms of equipment, he would want a camera that would show writing on the blackboard clearly. He mentioned that in Chem 20, some students preferred the lecture hall with the monitor as opposed to the live lecture.

In summary, the main areas of interest and concern that surfaced in these interviews are as follows:

1. Personnel: If video facilities are established, there is a need for staff who will be able to aid the professors, teaching assistants, and students in the use of the equipment. Staff would also be needed for the maintence of equipment and for routine work, such as taping lectures, copying tapes, etc. This raises the question of how many people would be needed for this staff.

2. Library Services: In addition to the above facilities, there is unaminous agreement for library services if work is being done with videotape. This would include cataloguing, storage, circulation, playback, and possibly copying facilities.

3. Cassettes: · There is an almost universal interest in cassette playback equipment for the labs and library. Ease of playback is a main factor in the requist for cassettes.

4. Playback Facilities: Most of those interviewed who taught laboratory courses want cassette playback machines in the labs. There is also interest in being able to bring playback equipment to a small room for playback to a seminar or tutorial group. A room in which playbacks to large groups at night could be scheduled,plus personnel to operate it, is requested. In addition, to the labs and a viewing room, viewing stations in the library are seen as being essential.

5. Color Equipment: In fields,such as biology, chemistry, and environmental health, where color identification plays an integral part of the subject being taught, great interest in color capabilities is expressed.

6. Link between the Yard and the Medical School: Most of the professors in the biology and chemistry departments are extremely interested in developing this link, although opinions differ as to how it is to be used. The various applications suggested are as follows:

    a. Small seminars, noon-time lunch groups, with two-way interaction.
    b. Courses.
    c. Large lectures, possibly with two-way interaction.
    d. Informal research groups.

APPENDIX I

Notes on the Interviews

1. Dick Oldham is designing the lecture halls. All four lecture halls have rear projection, while only lecture halls B and C allow for front projection. There is to be a portable remote control for the audio-visual equipment, enabling the lecturer, who cannot see the screens when he is standing by the blackboard, to move to a position where he can see the screens. The lighting in the room has three levels -- low, medium, and high.

2. The only cables presently in the science center are a couple of pairs of co-axial cable which run over the chilled water plant.

3. The ed school facilities include traditional audio-visual equipment as well as some recently acquired video equipment. The video studio is primarily set up to videotape group interactions. There are also two screening rooms that are serviced by the same projection room.

4. In order to get a brighter image off the scope, Bossert suggested using a processing amplifier. He also mentioned that some cathode ray terminals have a video output. In addition, he felt that the best recordings off a scope so far have been made with the G.E. camera and he would like to see it put in working order.

5. There is a similar microscope-video system in the Division of Engineering and Applied Physics which was used regularly by Ralph Mitchell in teaching microbiology.

6. According to Fields the cost of using super 8mm film is $140 per hour as opposed to videotape which is $30 per hour. Moreover, you can shoot over your old images with videotape many times.

7. Fields is interested in a computer that would allow disc base editing. In addition, he would want it to have a scan converter. He is also interested in its ability to put information in the cable, i.e. flash lights, ring bells.

8. Riddiford had problems with the actual shooting with film as well as getting it properly edited. By the time that the film loops were ready for use in the labs, it was over a year and some of the loops were obsolete.

9. Silvergleid is using videotape with ultraviolet filters to examine seeing mechanisms in insects. While out in the field, he also used it to tape army ants.

10. The Dentil School has two color cameras, a video mixer/switcher unit with special effects capability, two 1" videotape recorders (one with an assemble-edit capability), an optical film chain permitting multiplexing of 16mm film and 2x2 slides onto videotape, studio grid lighting in a 75-seat classroom, and remote wiring and portable synch generation to enable single-camera production at two remote locations in the school. The above is for production. They will be purchasing seven Sony cassette playback units within the near future.

11. Chemistry 20, which is taught by Frank Westheimer and Dave Dolphin, used a second lecture hall to which live lectures were transmitted with the use of video equipment because the class was too large to fit into one room. Dolphin said that some students preferred the video lecture over the live one. Westheimer objects to teaching classes as large as this last year's Chem 20 (400 students).

APPENDIX II

List of Faculty and Staff Interviewed

John Austin, Associate Director of the Office for Information Technology, Lecturer on Business Administration
Brook Baker, Laboratory Assistant for Biology 15
Paul Bamberg, Lecturer on Physics
Stephen Benton, Assistant Professor of Applied Optics on the Gordon McKay Endowment
Garrett Birkhoff, George Putman Professor of Pure and Applied Mathematics
Joseph Blatt, Media Specialist at the School of Education
Lawrence Bogorad, Professor of Biology
William Bossert, Gordon McKay Professor of Applied Mathematics
James Butler, Gordon McKay Professor of Applied Chemistry
David Cantor, Staff Assistant for the President's Office
David Dolphin, Associate Professor of Chemistry
Paul Doty, Mallinckrodt Professor of Biochemistry
Craig Fields, Assistant Professor of Psychology
Michael Gill, Assistant Professor of Biology
Owen Gingerich, Professor of Astronomy and of the History of Science
Gerard Kress, Director of Educational Research in Dentistry
Richard Lozeau, Assistant to the Director of the Science Center
Eric Martin, Lecturer on Visual Studies
Leonard Nash, Professor of Chemistry
Edward Purcell, Gerhard Gade University Professor
William Rice, Assistant Director of the Biochemical Laboratories
Lynn Riddiford, Associate Professor of Biology
Jacob Shapiro, Lecturer on Biophysics in Enivronmental Hygiene, Radiological Health and Safety Engineer to the University Health Services
Robert Silvergleid, Teaching Fellow for Biology
Otto Solbrig, Professor of Botany
Thomas Standish, Associate Professor of Computer Science on the Gordon McKay Endowment
Roger Thomas, Assistant Professor of Geology
Ronald Vanelli, Lecturer on Chemistry
Constance West, Administrative Assistant and Editor in the Office of Instructional Development in the School of Public Health
Frank Westheimer, Morris Loeb Professor of Chemistry
Charles Whitney, Professor of Astronomy
Edward Wilson,Professor of Zoology, Associate in Entomology
David Woodruff, Lecturer in Biology
Samuel Zanghi, Acting Director of the Division of Audio-Visual Education in the Graduate School of Business Administration
Michael Zeilick, Teaching Fellow in Astronomy

APPENDIX XI-E

Science Center Cable Trays:
From Conception to Realization

THE AIKEN COMPUTATION LABORATORY
DIVISION OF ENGINEERING AND APPLIED PHYSICS
HARVARD UNIVERSITY, CAMBRIDGE, MASSACHUSETTS 02138

Sci Center

24 March 1970

Mr. Richard C. Oldham, Associate
Ranger Farrell and Associates
Irvington-on-Hudson
New York, New York 10533

Dear Dick,

Since your excellent letter of February 24 to Hugh Russell, there has been complete silence except for one query to me by Dick Lozeau indicating that the architect was still having problems wrestling with the cable tray system.

Since experience in this area suggests silence is ominous, I should be grateful if you and Dick Lozeau would make it a point during your next visit in Cambridge to find out just where Sert and his people are on this matter and let Kothavala and me know. Thanks!

Sincerely yours,

Anthony G. Oettinger

AGO:chm

cc: R. Lozeau
R. Kothavala

XI-E-2

File

SCIENCE CENTER
HARVARD UNIVERSITY
CAMBRIDGE, MASSACHUSETTS 02138

Office of the Director
A-22 Lowell House
UN 8-7600, ext. 2284

January 21, 1971

Mr. Paul Krueger
Sert, Jackson & Associates
26 Church Street
Cambridge, Massachusetts 02138

Dear Paul:

For many months now the final resolution of the cable tray system has been left hanging. It has been quite a while since we've had a good look at the manner in which the tray works its way through the building. During this time, quite a few "minor" changes have taken place in the building. I wish to ensure that neither the concept nor the integrity of the cable tray system has suffered a loss. There is, for instance, the specific solution of how the tray is to penetrate through fire boundaries. This, to me, is a real elephant's tail. I would be much reassured if you could address yourself to this problem at this time.

Yours truly,

Richard C. Lozeau

ml

cc: George Homsy
Rustam Kothavala
✓ Anthony Oettinger

XI-E-3

THE AIKEN COMPUTATION LABORATORY
DIVISION OF ENGINEERING AND APPLIED PHYSICS
HARVARD UNIVERSITY, CAMBRIDGE, MASSACHUSETTS 02138

14 September 1971

Mr. Richard Lozeau
University Museum 50-E
Harvard

Dear Dick,

We came to no resolution in the fleeting moments after the question of "Oettinger's Cable Trays" was raised by Dick Leahy at the Science Center Committee meeting on September 13. Accordingly, I am here setting forth my perception of the issue. Please circulate this among members of the committee, so that we might work toward settling how best to bridge the gap between the $23,000 budget and the $46,000 current estimate for the tray system. I'll present alternatives that come to my mind at the conclusion of this memorandum.

This is not "Oettinger's" system but the Science Center's. I do not make this disclaimer to shed responsibility for the idea and its eventual success or failure. I stress that while it seemed appropriate for me to accept delegated responsibility for the technical details of this matter, the budget decision affects everyone who will ever use the Science Center. The whole committee should participate in the decision.

The idea of the cable tray system is based on the following premises:

1. Demand for electrical telecommunications of every sort will sharply increase during the lifetime of the Science Center.

2. There is no way to predict in detail in what form and at what rate this growth will happen.

3. Schools that have invested heavily in modish equipment have quickly found it useless, obsolete or both.

As to the first point, people will want to televise live experiments to the lecture halls or other classrooms either from laboratories within the building or, through the cables of the Harvard Information Transfer System (HITS) from elsewhere in the university. Live and videotaped materials from other sources are also likely to be used. Links from consoles to computers will play an increasingly important role for a variety of pedagogical purposes. Remote metering and control of experiments or demonstrations may prove useful. The variety of uses for analog or digital electrical signal transmission today is large and the list can be expected to grow. The facilities required might range from a simple twisted pair of wires to coaxial cables with elaborate amplifiers.

The second point stems from the fact that we simply do not know enough either about the potential of the various modes I have illustrated in the preceding paragraph or about the preferences of faculty and students, to make a sensible guess about a mix of facilities that snould be installed permanently.

The third point reflects the fact that the guesses made to date have mostly been wrong.

The idea of the cable tray system arose from our search for a way that would, at the least possible cost, provide for growing into as rudimentary or as complex a telecommunications system as we wish, as faculty and students wish to meet specific needs. This implies a facility for stringing cables between any two points in the building and from anywhere in the building to its two major links to the outside, the HITS and the facilities of the Bell Telephone System.

The obvious solution of doing absolutely nothing has the serious demerit that reversing the decision is difficult. Stringing cables along the walls and floors is unreliable, unsightly and hazardous to passers-by. The alternative, in our other buildings where we have faced this problem, has typically involved searching for unused conduit space -- always in short supply or totally absent -- and, in many instances, unpleasant and expensive drilling through floors and walls. Neither of these alternatives lends itself to spontaneous experimentation followed, when warranted, by orderly growth.

We could have recommended the laying of spare conduit but this, in itself, would have entailed some cost. Moreover, we wished to assure that the matter of cable laying would, in its protracted experimental phase, be something that faculty members, teaching fellows and students could do themselves with a minimum of fuss. This requires some easily accessible scheme not requiring professional services for snaking cables through conduits, junction boxes, etc. The system has to be independent of the telephone system to avoid conflict with telephone company policy, mutual interference, usurious charges and intolerable delays. It has to be independent of the electrical power distribution system, to avoid conflicts with the electrical code, shock hazards, etc. It has to be independent of Buildings and Grounds to minimize costs and maximize do-it-yourself ability to put something together on short notice.

The idea of cable trays run along corridors, at a height conveniently reached by an outstretched arm, connecting from floor to floor through one of the open shafts inherent in the building's structural design and connectable through a junction in the basement to telephone and HITS services, seemed like a solution which would meet the foregoing criteria without entailing the expenditure of one penny on a cable until someone actually saw an explicit need for one.

When the idea was presented to the committee a couple of years ago, it was well received and greeted with particular enthusiasm by those who had had prior experience with trying to string any kind of wires in an existing building.

The recommendation I made was that trunks be provided along main corridors to the common shaft, with feeders to the minor corridors and holes providing access from every room to an adjacent corridor.

It now appears that the amount that was budgeted, approximately $23,000, will supply only enough trays to reach about half of the buildings. The full system, as I understand it, would cost about twice that much.

The alternatives that occur to me are therefore:

1. To junk the system entirely;

2. To curtail it selectively so as to make the budgeted trays either supply trunks on all major corridors or else provide also for feeders into areas most likely to use the system, leaving portions of the building without either trunk or feeder facilities; or

3. To agree collectively on cutting something else out of the budget in favor of installing the full distribution system.

I think it is clear from the introduction that I believe the third alternative to be in our best interest. The facility should stimulate, if not the faculty, at least many graduate and undergraduate students, to experiment with facilities that may well, in another ten years, be among those critical features which distinguish this building from one that might have been built 50 years ago.

If there's to be selective cutting, I think it essential that any area not interested in the tray system be asked to beg off in writing, with the understanding that future installation of tray facilities into their area would be borne as a departmental expense. I should certainly not wish to sit down with Dick Lozeau and the architect and make arbitrary determinations about where the trunk system should go and where not.

Until returns are in on these two alternatives, it seems excessivly pessimistic to consider the first. However, the pattern of reactions to the second alternative might suggest that it be better to abandon the scheme: pieces of tray with gaps between them will serve no one. Indeed, like the Post Office or the telephone network, the cable tray system's value depends on the extent to which it can reach practically anyone, practically anywhere in the building, the university and beyond.

This is one of those services from which none can benefit unless all do. Being everyone's business, it risks being no one's. Because of prior experience and interest in this matter, I accepted the delegation of responsibility for looking after technical details. This budget question, however, is a collective issue which must be resolved collectively.

Sincerely yours,

Anthony G. Oettinger

AGO:chm

cc: Dean J. Dunlop
Dean R. Leahy

XI-E-7

HARVARD UNIVERSITY
PIERCE HALL, CAMBRIDGE, MASSACHUSETTS 02138
OFFICE OF THE ASSOCIATE DEAN

DIVISION OF ENGINEERING AND APPLIED PHYSICS

September 16, 1971

Science Center
File

Mr. Richard Lozeau
Harvard University
University Museum 50-E

Dear Mr. Lozeau:

I should like to add a note of support to Tony Oettinger's assertion that the cable trays proposed for the Science Center should have a very high priority and should be extended throughout the building from the beginning. We have had some experience in Pierce Hall with attempting to install video and audio communications, and while it is always possible, it is both expensive and sometimes frustrating.

It is difficult to make long-range forecasts of space utilization in any science area; this is doubly true with the Science Center. This suggests that every effort should be made to provide the most flexible and adaptable facility that can be designed. The cable trays are important in this regard and thus should be given a very high priority in fund allocations.

I hope you will pardon my intrusion into this matter since I am not in fact a member of the Science Center Committee. However, my experience with regard to audio-visual communication systems within the Division provoked these comments.

Sincerely yours,

Peter McKinney

Peter S. McKinney

PSM/mm

cc: A.G. Oettinger

XI-E-8

File

HARVARD SCIENCE CENTER
HARVARD UNIVERSITY
CAMBRIDGE, MASSACHUSETTS 02138

Office of the Director
University Museum 50-E
617 495-2627

September 24, 1971

Memorandum to: Members of the Planning Committee

From: Richard C. Lozeau

At the Science Center Committee meeting of September 13, 1971 it was announced that the final price for the installation of the Science Center Cable Tray System had come in at $24,000 above the originally budgeted $23,000. Two causes were cited for the increase: 1) an increase in scope, and 2) the necessity of purchasing a standard cable tray rather than a hoped-for less expensive alternate. The increase in scope was justified in that it represented essentially a "better definition of scope" than was available on the Spring 1970 bid documents.

Although some alternatives were discussed at that meeting, the issue was left essentially unresolved. In a back-up letter to me on Spetember 14th Professor Oettinger underlined his position that the Cable Tray System was a matter of collective responsibility and brought the issue into focus by enumerating the alternatives facing the Committee. This letter was distributed to members of the Planning Committee and a telephone survey was conducted from September 21-23 to solicit their reactions to Prof. Oettinger's letter. The following conditions influencing the decision were pointed out during the survey:

1) that owing to an error in the plans the corrected increased cost was $17,800 rather than $24,000

2) that a decision to go ahead with the $17,800 add for the Cable Tray System meant that a matching sum would have to be deleted from some other area of the project, probably the lecture halls

Eleven members of the Committee voted for the Cable Tray System; one was opposed. Dr. Vanelli dissented bacause he did not feel that the cable tray would be widely used and therefore thought the $17,800 could be put to better use elsewhere. Most members felt it unwise to try to cut costs by deleting trunks in selected areas of the building.

XI-E-9

17 January 1972

TO: Dave Cantor
Steve Farber
Al Pandiscio

cc: R. Lozeau

Gentlemen:

I'm enclosing a copy of a memorandum dated January 14 from Dick Lozeau to George Homsy.

I think it might be well for the working group on telecommunications to consider what might be done, with respect to item one in the enclosed memorandum, to establish clear possession of the cable tray system. I fear the strong temptation to Buildings and Grounds and others to establish squatter's rights in the interval between now and the first evidence of interest in the cable tray system by the ultimate occupants of the building.

Sincerely yours,

Anthony G. Oettinger

AGO:cmb

XI-E-10

1) Xerox to Al Paradisc
Dave Canto
Steve Farbe

HARVARD SCIENCE CENTER
HARVARD UNIVERSITY
CAMBRIDGE, MASSACHUSETTS 02138

2) File

Office of the Director
University Museum 50-E
617 495-2627

January 14, 1972

Memorandum to: George Homsy

From: Richard C. Lozeau

Jack Williams, Prof. Oettinger and I met at the site on Thursday, January 13 to review the Cable Tray System. The following points were resolved:

1. That the effort to keep the Cable Tray System clearly separate from all other easements and cable runs in the building be strictly maintained. The cableways are strictly for user convenience; telephone lines and power lines must be accomodated in other ways. Porf. Oettinger suggested labeling the CWP conduit run to underline this condition.

2. That a cable tray run be brought into the library basement area as part of the Phase II development.

3. That the cable tray remain above the nine foot height where it crosses corridor B37 near the telephone and electical equipment rooms.

4. That the cable tray run below the nine foot level along the north wall of the basement corridor.

5. That three 3 inch sleeves rather than six 2 inch sleeves penetrate the firewall at the cable tray shaft on each floor of the building.

6. That two 4 inch holes in the slab would be adequate access in the 5th through 8th floors where the slits in the plank were inadvertently left out.

ml

cc: Prof. Anthony Oettinger
Mr. John Williams

XI-E-11

HARVARD UNIVERSITY
DEPARTMENT OF BUILDINGS AND GROUNDS

RECEIVED
MAR 3 1972
B. C. L.

MEMO TO: R. Lozeau

FROM: G.L. Homsy

DATE: 2/28/72

SUBJECT: Harvard University Science Center

I am instructing Turner Construction Co. by copy of this memo to do the following:

Blank off and identify the ends of the single 4" H.U. communication cable conduit, located in the CWP, in such a way that no use will be permitted of this conduit except per Harvard approval.

cc: J. Greenip
R. Corney
J. Shea

Xerox to Jack Austin
HL Pandiscio

File: Science Center

This had better be specified as OIT. Otherwise B+G might, some day!

XI-E-12

File

HARVARD SCIENCE CENTER
HARVARD UNIVERSITY
CAMBRIDGE, MASSACHUSETTS 02138

Office of the Director
University Museum 50-E
617 495-2627

April 19, 1972

Mr. George Homsy
Holyoke 600

Dear George:

I write this note in the hopes of preventing a future administrative and jurisdictional problem. As you know, the cable tray system extends into the basement space beneath the preparation room. This same space is occupied in part by various service machinery for the lecture halls. Since we require unrestricted access to all parts of the cable tray system, we will have to use the same basement access hatch as the maintenance personnel and presumeably will have to pass through a space in which equipment is operating. If this condition is unacceptable to the operating engineers, then adjustments will have to be made such as the construction of wire enclosures or some such thing.

Will you please let me know if there will be any difficulty here?

Yours truly,

Rich

Richard C. Lozeau

ml

cc: Dean Richard Leahy
Mr. James Ingraham
Prof. Anthony Oettinger

~~[illegible]~~

2) file

XI-E-13

HARVARD SCIENCE CENTER
HARVARD UNIVERSITY
CAMBRIDGE, MASSACHUSETTS 02138

of the Director
ity Museum 50-E
7 495-2627

April 13, 1972

George Homsy
yoke 600

Dick: need any help?
Barry

r George:

This is to confirm and add to our conversation of yesterday which I informed you that some problems existed with the ement cable tray. The placement of the cable tray was arently not sufficiently considered during the basement vice coordination meetings held early in the job. At any e, there is no room to place the tray above the nine foot rs. There is, also, only eight inches available at some ations between the door frame and the adjoining wall if ine of sight is taken down the length of the corridor. ittle more space is available if the tray is wrapped around columns. Jack Williams asked me to help him resolve this ficulty and we came up with the following solution:

1) that the cable tray extending from the telephone room to the x-cable shaft would run line of sight along the corridor wall and would be six inches wide rather than the previously called for eighteen inch tray
2) that the cable tray west from the x-cable shaft would consist of two six inch trays stacked one on top of the other until a location is reached where a clear run wide enough for the wider tray is available

Thanks Barry
I don't think so at least at present. The solution is not as neat as we would have liked ~~[illegible]~~ but it should work ok.
Dick

Jack and I also went through the proposed routing of the le tray into the lecture hall areas. The work had apparently been clearly detailed for the vendor as yet.

I should remind you also that the cable tray will be ended into the library basement and that the cost of this ension is to come as part of the $250,000 cost for the rary basement expansion.

Yours truly,

Richard C. Lozeau

Dean Leahy, Mr. Krueger, Mr. Williams, Prof. Oettinger ✓

XI-E-14

SCIENCE CENTER
HARVARD UNIVERSITY
CAMBRIDGE, MASSACHUSETTS 02138

Office of the Director
University Museum 50-E
617-495-2627

MEMORANDUM

June 27, 1972

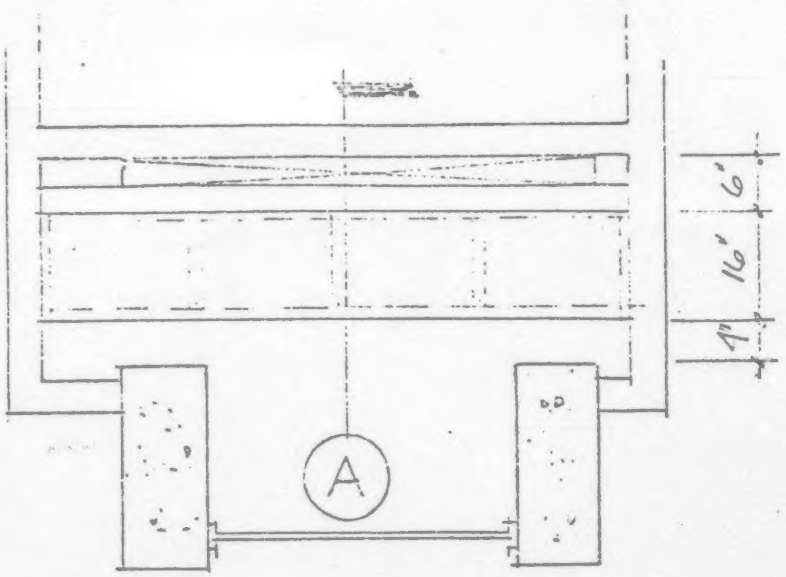
TO: Professor Anthony Oettinger

FROM: Richard C. Lozeau

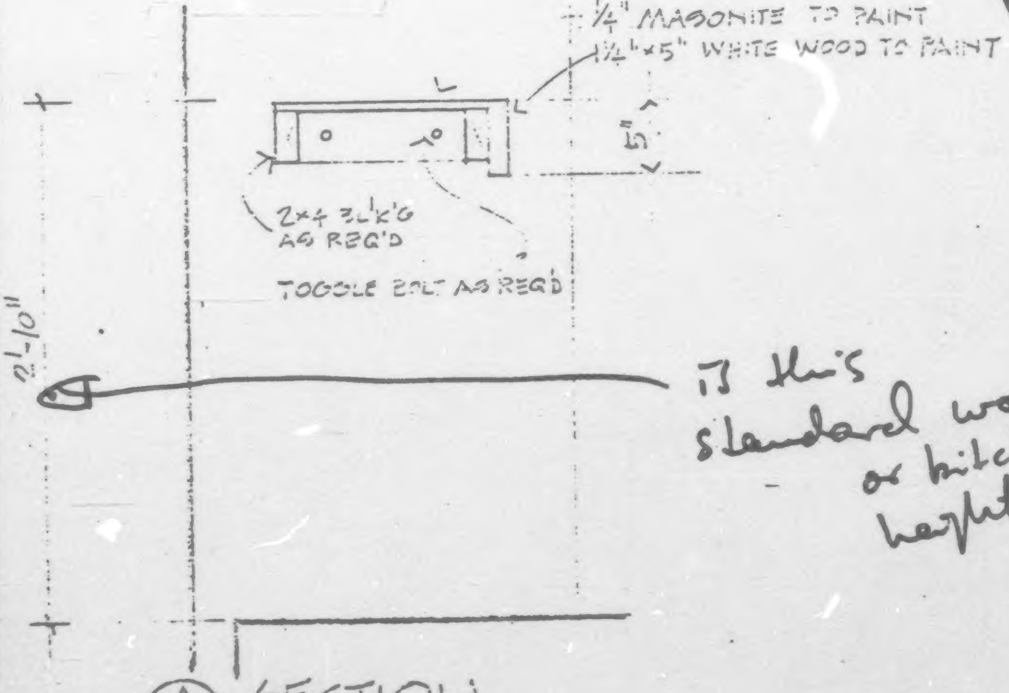
Attached is a detail of the proposed shelf in the x-cable rooms. Please review for approval.

Attachment
RCL:nds

Xerox to Science
Center file
Original to
Lozeau



1 PLAN - X-CABLE RM
A763 SCALE 1/2" = 1'-0"


1/4" MASONITE TO PAINT
1 1/4" × 5" WHITE WOOD TO PAINT
5"
2×4 BLK'G AS REQ'D
TOGGLE BOLT AS REQ'D
2'-10"

A SECTION
763 1" = 1'-0"

I trust there is provision for adequate a/c power (at least 3 or 4 double outlets) in each closet. Where are they relative to bench?

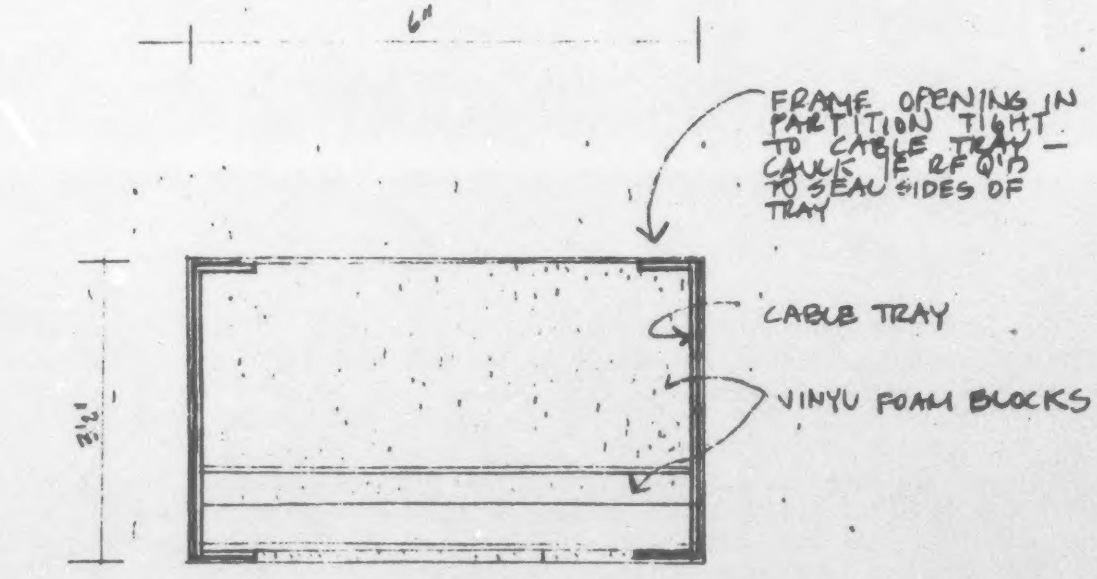
Is this standard work-bench or kitchen counter height? It should be.

JACKSON & ASSOCIATES
[illegible]
[illegible]
CHUSETTS 02133

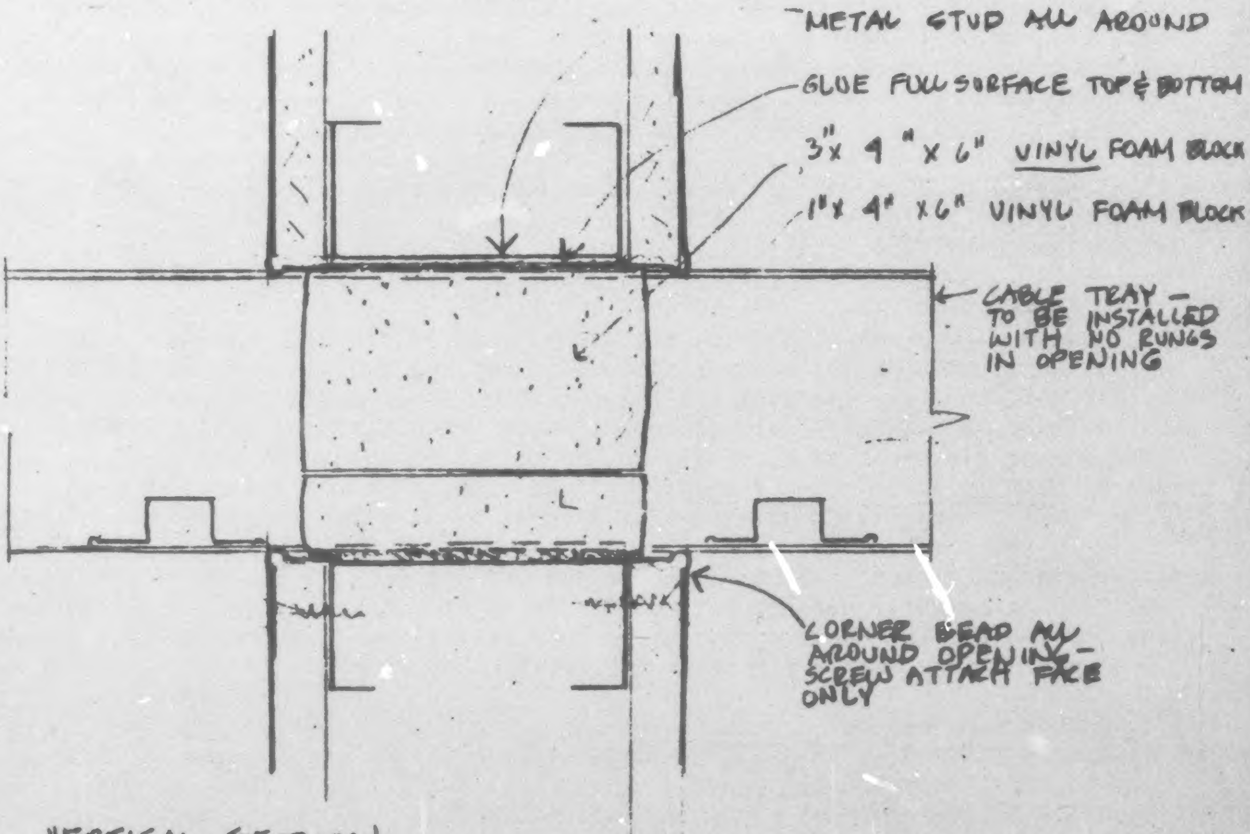
SCIENCE CENTER
X-CABLE ROOM

DATE 20 JUNE 72
SCALE AS SHOWN
DRAWN CKS
APP'D

6803
A-763


6"
3 1/2"
FRAME OPENING IN PARTITION TIGHT TO CABLE TRAY - CAULK IF REQ'D TO SEAL SIDES OF TRAY
CABLE TRAY
VINYL FOAM BLOCKS

ELEVATION


METAL STUD ALL AROUND
GLUE FULL SURFACE TOP & BOTTOM
3" x 4" x 6" VINYL FOAM BLOCK
1" x 4" x 6" VINYL FOAM BLOCK
CABLE TRAY - TO BE INSTALLED WITH NO RUNGS IN OPENING
CORNER BEAD ALL AROUND OPENING - SCREW ATTACH FACE ONLY

VERTICAL SECTION

[illegible]

CORRIDOR WALL OPENING FOR CABLE TRAY

DATE 4.13.71
SCALE 1/2 FULL
DRAWN HAR
APP'D

6803

A·33

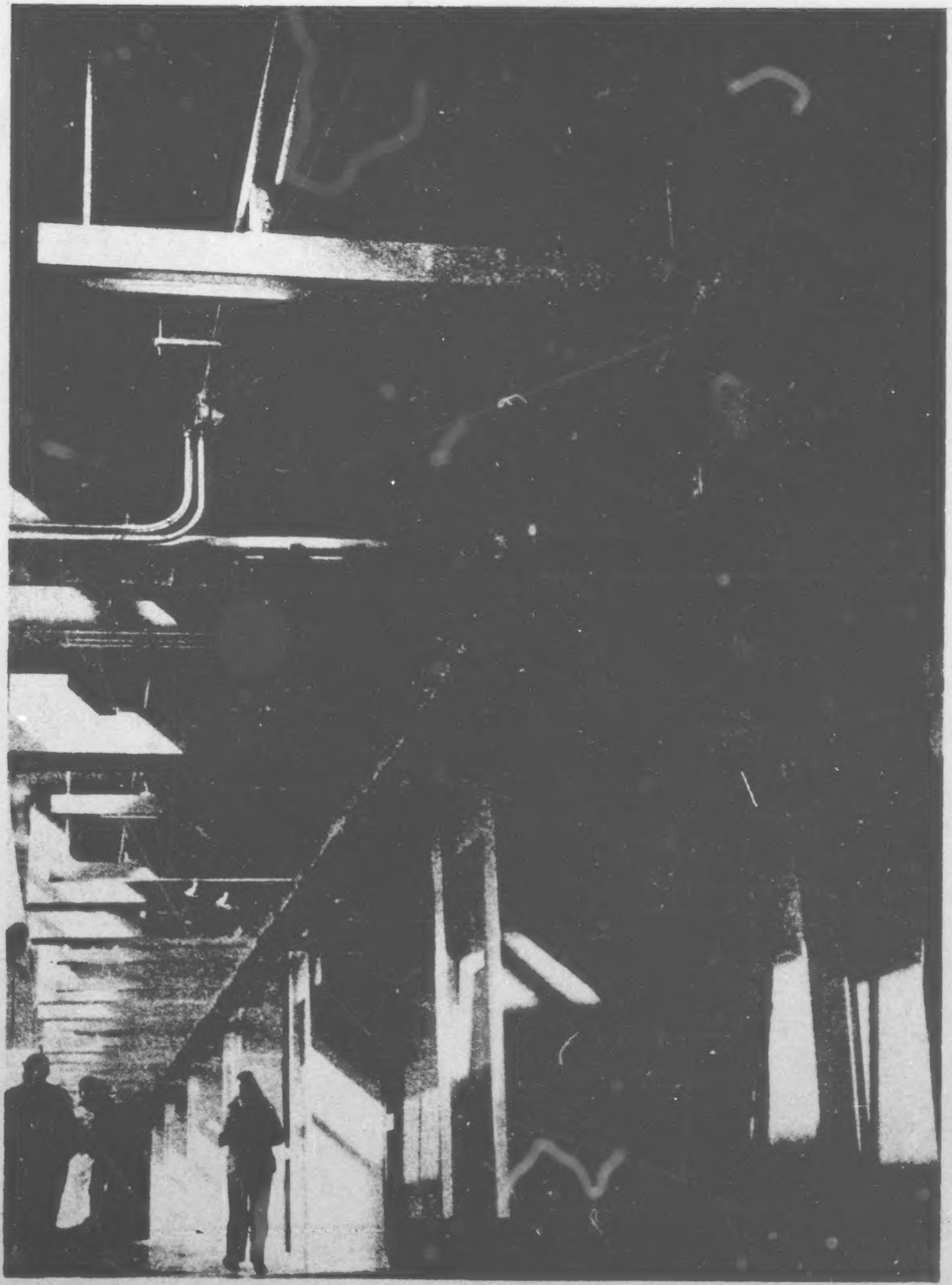


Figure 1

Typical Main Corridor Trunk with Branches

Figure 2

Column Closet, with Inter-floor Cable Drop Space at Rear

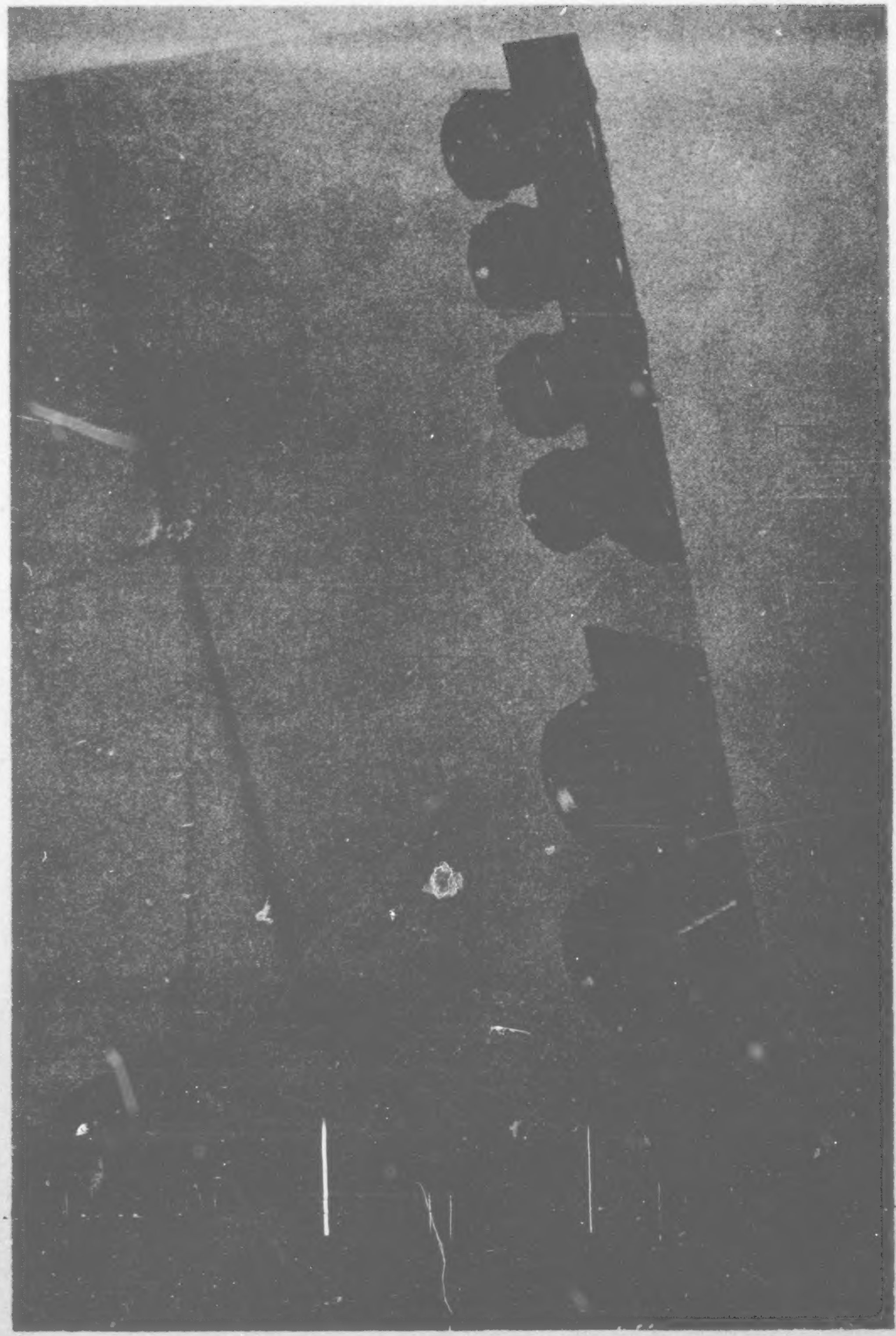


Figure 3

Access From Main Corridor to Column Closet

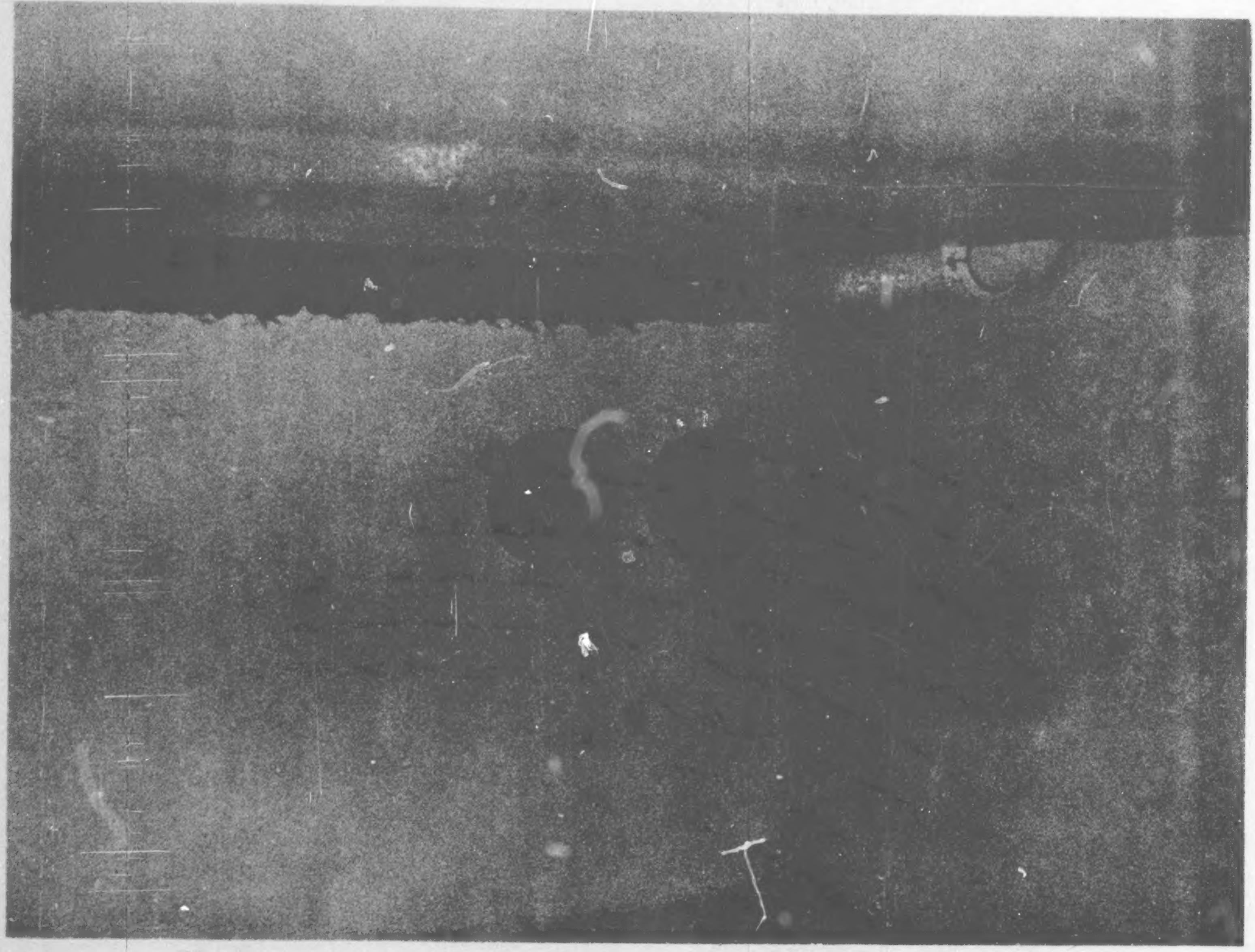


Figure 4

Access From Corridor to Lab or Class Space

APPENDIX XI-F

A Tale of Remodeling

XI-F-1

THE AIKEN COMPUTATION LABORATORY
DIVISION OF ENGINEERING AND APPLIED PHYSICS
HARVARD UNIVERSITY, CAMBRIDGE, MASSACHUSETTS 02138

TACT Doc Book
#97

26 October 1970

Dr. R. Z. Kothavala
University Museum 50E
Harvard

Dear Rusty,

This letter is in response to your request for a detailed listing of the design flaws I have observed through using the Harvard Hall facility. This listing is intended to help in avoiding similar problems with the Science Center design. With luck we may avoid some of these pit falls but I am sure this does not exhaust the potentialities! Accordingly, I continue to think that contractual arrangements of the type I outlined in my letter of 28 September are an absolute necessity and must therefore be worked out.

1. My experience with slide projection in Harvard Hall is precisely like yours as recounted in Bruce Humphrey's letter to Dick Leahy dated 19 October.

2. It is extremely difficult to keep track of what is being presented on the screens even assuming the images to be visible to the students. The rear projection screens do not lend themselves easily to the use of a light pointer. Moreover, without craning his neck to the straining point or falling off the platform, the lecturer is unable to see what's on the screen. We might experiment with a mirror arrangement that would permit him to see the screen image while continuing to look at the class. The same problem arises with the TV monitors but it is easier to solve it in this case: provision should be made for a small monitor on the table so that the lecturer may view precisely what the class sees.

3. The stability of the TV monitors is terrible. So long as manufacturers are unable to provide increased stability which, in any case, depends on the quality of the input signal as much as on the monitors it must be easy to adjust the controls on the monitors. The fact that two of them are suspended from the ceiling and out of reach without dragging in a ladder has led to many comedy situations in our classroom.

4. The monitor control panels are locked for security. However, this also precludes adjustments from being made by the staff! In fact, the whole lecture room is ridden by multiple locks for which the right keys never seem to be available at the right time. This includes the transom and the projection room itself. Any lecture room containing audio-visual devices should have in it a cabinet containing all necessary keys. The key tags should have labels and the hooks in the cabinet should have corresponding labels to facilitate key return. A single key to that cabinet provided to each staff member using the room would help avoid this problem, although it doubtlessly would not eliminate it entirely.

5. A telephone should be available either in the lecture room or in the projection room. No matter how well things are planned, last minute emergencies keep arising and its a long run from Harvard Hall to the Boylston Basement and back. I think this would apply with equal force to the Science Center.

6. Although every amateur photographer knows better, the lights that shine on copy to be viewed through the overhead TV camera are almost perpendicular to the copy. Such lights should be angled near 45 degrees.

7. All moveable apparatus should have provisions for positive index stops to help restore it to proper position after servicing or other planned or unplanned moves. This includes projectors, whether rear or front, the lecture table which must be positioned precisely under the TV camera, etc. Cup depressions in a floor or angle irons or right angled wood pieces would do the trick for tables, projectors, mirrors, etc.

8. If a loft is to be provided in any lecture room, access to it should be possible without special apparatus or if the entrance is unavoidably above arm level a step stool should be mounted on the wall like a fire extinguisher to be handy whenever needed.

9. It is difficult to cue either audio tape or the record turn table without holding down a spring loaded switch. It would be easier to fix this through appropriate design modifications than through breeding three-handed assistants.

10. No provision was made for bringing in a videotape recorder and playing it to the lecture monitors. Consequently whenever we've originated something from the Matthews basement or brought a VTR to Harvard Hall itself this has meant patching the video and audio signals into the equipment with clips and solder. If, indeed, such facilities exist but we have been unable to find them, this comment translates into a criticism of the non-existent operating manual for the system.

11. Any contract for future equipment should include as part of the specifications the production, delivery, approval, and revision of an operating manual intelligible to lay users and of a maintenance manual with complete wiring diagrams, etc., etc., usable by normally trained technicians.

12. There should be work lights in the projection room, one near the projection counter to help the operator see what he is doing, and one on the equipment rack to go on with the rack power supply since the overhead lighting is very poor.

13. There should be large numbers on the projectors and their controls to help identify each projector with its screen.

These are minor matters which people forget rather quickly since one gets used to hanging. However, our objective should be to make facilities usable with a minimum of training and habituation by instructors and course staffs. Everything will work if there is enough planning, rehearsing, and rigidity in a presentation, but it is much harder to achieve a degree of informal flexibility of the type one has come to associate with printed media.

14. There is provision for audio recording, but the tape recorder as presently constituted makes no provision for locking out the record button nor is there any light on the desk control panel to show when recording is in progress. Accordingly, recording is inconvenient and there is a risk of catastrophe through wiping out a valuable tape.

15. The hydraulic lift for the lectern is a disaster. If one pulls out the elevating rod there is no easy way to get in back in.

16. The use of pilot lights that look like push buttons as on the room light switches on the console continues to be a source of frustration. I push them but nothing happens until I remember that they are merely indicators and that the square button to their left cycles through the lights. By that time I am so panicky that it usually takes me two cycles to get where I want, particularly since many of the lights are fluorescent and there is a delay in their response to the button push!

17. There should be an intercom from the lecturer's desk to the projection room. Loud shouting will do, but produces comedy effects that are not always desirable.

Sincerely yours,

Anthony G. Oettinger

AGO:chm

cc: Dean Leahy
Bruce Humphrey

XI-F-4

HARVARD SCIENCE CENTER
HARVARD UNIVERSITY
CAMBRIDGE, MASSACHUSETTS 02138

Office of the Director
University Museum 50-E
617 495-2627

November 5, 1970

Memorandum to: Dean Richard Leahy

From: Rustam Z. Kothavala

Re: Harvard Hall 104

This memo is a supplement to the enclosed copy of a letter from Tony Oettinger. It contains a listing of the desgin flaws in Harvard Hall 104 that have come to my attention through teaching Natural Sciences 10 in that classroom this year. It is purely for your information. I am sending copies of this material to the architect so that he may ensure that the same errors do not occur in the design of the Science Center audio-visual facilities.

1. The work surface and control panel are far too low.

2. The control panel is too crowded and there is no logical organization to the buttons. Consequently, I am constantly forced to stop my delivery and examine the panel to pick out the desired button. A clear color code for the buttons would be of great help. Further, if the button panels for each projection screen were set up on the control panel in the same order that the actual screens are set up, it would save a lot of fruitless searching.

3. The TV monitors are poorly located. They make much of the blackboard space unusable in practice.

4. The resolution of the TV monitors is not good enough to even project tables of figures on white paper. Unless standard type is clearly visible on the TV monitors, the overhead projector is useless as an educational tool. The monitors in Harvard 104 do not have enough resolution to even show line graphs.

5. The suspended monitors are poorly located. They hide the blackboard from many seats in the rear of the classroom. The stage lights shine onto the projection screen and there seems to be no way to adjust their directions.

6. In spite of all the claims that have been made for rear projection, I find that the screens lack the degree of

resolution that is essential for visual material in my course. Further, both the screens and the mirror system get covered with dust. It takes a lather to clean the former, a professional technician to clean the latter.

7. The strongest claim for rear projection screens is that the room does not need to be darkened. That is certainly not true in Harvard 104. The ceiling lights reflect directly off the front surface of the glass screen making slides completely invisible from many seats in the classroom. Further, the people in the rear of the room pick up the reflection, off the glass projection screens, of any activity in the loft.

8. I completely share Tony's frustration over the way in which the projectors are constantly going out of adjustment.

9. The door on the north side of the room seems to have the noisiest hardware in Harvard College. I have taken the step of obtaining a key for it and leaving it locked during my class. Before that, every latecomer effectively brought the class to a halt.

10. The room lights are controlled at three levels of lighting that are cyclic. This is both painful and unnecessary. For example, if the lights are on dim and I wish to turn them off I have to press the button three times, going through moderate and bright lighting in the process.

11. Tony has pointed out that a ladder is needed in order to reach the loft. Getting up there has many of the elements of a Marx brothers movie.

12. One of the major claims made in touting all this gadgetry is that the teacher is then free to address himself to the class. That is nonesense. I too have been forced to engage in shouting matches with the operator. And yearn for the old-fashioned simplicity of maintaining visual contact with my untrained Teaching Fellow who easily operated three different kinds of projectors onto front projection screens in Burr A.

13. It would help a great deal if a space had been left at the rear of the classroom for using direct projection.

XI-F-6

See also: Science Cent File

BOYLSTON HALL ○ HARVARD UNIVERSITY ○ CAMBRIDGE, MASS. 02138

November 12, 1970

Memorandum to: Dean Richard Leahy

From: Bruce A. Humphrey

Re: Harvard Hall 104

This memo consists of a detailed breakdown of the problems encountered in using the media system in Harvard Hall 104. It is meant as a supplement to the letters from Tony Oettenger to Rusty Kothavala dated Sept. 28, 1970 and Oct. 26, 1970, and to the letter from Rusty to Tony dated Oct. 7, 1970, and the memo from Rusty to you dated Nov. 5, 1970.

As a summation of the problem list enclosed, it seems to me relevant to examine the design rationale that produced a system so fraught with problems and drawbacks. It has become my firm conviction after years of working with audio and visual media equipment that whenever a piece of equipment that will in operation require extensive manipulation by people is designed by a person primarily oriented to theoretical engineering concepts, that equipment will be awkward to handle and inefficient in operation. To put it more simply - a tape recorder designed by a PHD in Engineering who has never had to run a recorder under pressure for 10 hours a day will rarely be an easy recorder to operate.

What apparently has happened at Harvard Hall 104 is that it has been designed by very intelligent people who exhibit little evidence of having spent any significant time projecting slides, showing movies, recording classes, making photographs or video tapes, or, most pointedly, teaching a class and bringing to bear a variety of media elements.

The kind of formal design capabilities exhibited in the 104 system design form an indispensible part of the talents that should shape such a facility, but they are only one of many requirements. Plainly, far too much faith was placed in a design approach from theoretical grounds, assuming that of course a system so designed would, by its inheritance, answer 90% plus of all problems. In reality, it should seem now to many painfully clear that vastly more consultation should have been done with faculty and staff people intimately familiar with the day to day 'nuts and bolts' problems of utilizing and presenting media materials in a classroom context. This approach, combined with the procedure suggested by Tony Oettenger of a trial and correction period as part of installation contractual arrangements, would go a long way toward making future installations much more useful and workable.

cc: Oettenger
    Kothavala

XI-F-7

BOYLSTON HALL ○ HARVARD UNIVERSITY ○ CAMBRIDGE, MASS. 02138

HARVARD HALL 104 MEDIA SYSTEM PROBLEMS November 9, 1970

1. The Rear Screen Projection System

A. It seems highly questionable whether, given the viewing angles dictated by the seating in the classroom, a rear screen system should have been chosen. An inherent drawback of rear screening is a narrow angle of view with 50% of brightness relative to center maintained at reasonable angles off axis. The image brightness falls off drastically for viewers seated in the side sections, and more so for front row viewers, and worst of all for the instructor at the lecturn. Screen materials can be chosen to increase the acceptable angle of view, at the loss of total gain or brightness, which would be unacceptable with the projector wattages supplied.

B. Rear screen image size:
The width of the individual screens is 60", with images from none of the projectors filling more than 50". A rear screen system such as this limits image size and image size flexibility. The average 50" images are too small for many materials. The image size from the two 2x2 projectors are un-equal, because of mis-matching of focal lengths and light path lengths. The size of the mirrors seems marginal, limiting the projector adjustment flexibility for image placement on the screens.

C. Mirror chamber design:
No provisions whatever were made to render this space dust-proof, or at least dust resistant. The result is a rapid build-up of dust on the upward facing mirror surfaces, which degrades the image brightness and contrast, and, whenever the surface is touched, which it shouldn't be, but experience proves is, the image is further degraded by this pattern in the dust.

D. A rear screen system is supposed to provide sufficient image brightness and contrast in a normally lighted room, but it has been found that room light levels need to be reduced in Harvard Hall 104 to enhance image quality to an efficient level. However, with the room lights set on the low position the remaining light fixtures still on at the side of the room reflect directly off the rear screen surfaces as seen by all those seated in both side sections. This seriously degrades the image quality for these viewers.

E. A theoretical advantage of rear screen systems is that a lecturer standing in front of the screen does not block the light path between the projector and screen. This advantage was not utilized, given the screen placement above the lecturers head. This was apparently done to provide more eye level chaulkboard area. The high screen placement aggrevates the viewing angle problem for the instructor, without providing ample chaulkboard area, judging from comments by instructors using the room. It is noted that, except for the light path blocking problem, all of the difficulties detailed in item 1. would have been avoided with a front projection system.

2. The Lecturn Desk, Operating Panel, and Stage Layout Design

A. The remote control panel reflects probably the greatest amount of thought donated to any single element of the room as a whole, yet it exhibits some specific problems that bear examination.

a. The portion designated for right screen control actually controls the screen to the instructors left as he faces the class, which is his normal position of reference.

b. The house light switch requires consequitive punches of a single switch while separate pilots indicate the level attained. The pilots, however, look like switches, and most instructors are confused into punching the pilot, with zero results. The switching is sequential, and with the delay of fluorescents, it is distracting to go through all light levels to obtain the one wanted. There should be a separate switch, with built in pilot, for each light level. Each switch should push once for on and once for off. If medium is pushed while low is on medium should be immediately obtained, or if high is pushed while low or medium is on high should be obtained. All panel control switches, by the way, should have built in pilots glowing at one half intensity in the off position to facilitate locating in a darkened room.

c. The video camera focus drive speed is too fast, resulting in several overshoots before sharp focus is attained.

d. The lecturn microphone model chosen performs well acoustically and electrically, but not mechanically. The cable reel is only partially successful. It pulls back with sufficient force to have already severely strained the cable at the entrance to the microphone body. A mike type with a built-in connector should have been chosen.

e. The light box for viewing large transparencies with the overhead video camera is faced with opal glass, which has been broken. It should have been faced with translucent white plastic.

f. The lecturn desk is provided with castors, but no indexing sockets were provided in the floor for the castors. The result is that the desk top and the light box are constantly getting out of register with the ceiling video camera.

g. The lecturn lift arrangement defies all reason and sensibility. It utilizes an automotive hydraulic jack. A handle must be inserted through a hole in the desk rear face, (done best on ones knees) and then, by feel alone, engaged with the elevating socket. Many strokes are required to raise the lecturn a fraction of an inch at a time. To lower, another socket must be engaged by feel. The whole affair is completely ludicrous.

h. The entire remote switching operation is based on controlling AC power to the projection, sound, and video equipment. Various drawbacks obtain. The most serious is the 45 second delay in waiting for the video system to warm up and achieve an image. This subtracts greatly from the spontaneity needed to keep a class pace going when it is desired to show material on the spur of the moment. The warmup requires specific planning on the part of the instructor to accommodate the warmup the warmup delay, and this is precisely the sort of thing such a system should not encumber an instructor with. In addition, the switching circuits induce a loud pop in the audio system.

i. The switch for the electric drop front projection screen is located inside the control booth. This screen obviously would be used with a projector positioned in the transom, and the switch should be located on the lecturn desk or in the transom, or both.

j. There is no audio system volume control on the lecturn desk. There is a volume control located at the back of the stage next to the booth door. Experience has shown that sound level needs to be adjusted often during a class as different audio sources are used. It is almost impossible for an operator in the booth to adjust level from that point to a comfortable level for the audience - it needs to be done by someone in the classroom, preferably the instructor, but it is very distracting and difficult when he must leave the desk and turn away from the class.

k. Much can be said for the recommendation made prior to the installation that the record player be located within the lecturn desk. This would allow an instructor to start and stop a disc without complicated cue arrangements with an operator. The best scheme would be to have both disc and tape players at both locations. A specific limitation of the AC power switching is that only one disc selection or band can be pre-cued by an anstructor, who then can only turn on power to the player without further remote band selection. The non-remoteability of normal record player functions is the prime argument for a lecturn desk location for this unit, in keeping with the expressed basic concept of the Harvard Hall 104 system as being 'teacher operated'.

l. The operator call buzzer is loudly amplified over the sound system when the lecturn mike is on.

3. The Audio Equipment Rack in the Projection Booth

A. The record player, despite forewarnings by the undersigned and others, is positioned directly above the Sola power supply, with a high hum level resulting when records are played.

B. The tape recorder, again despite forewarnings was supplied as a 7 1/2 and 15 ips machine. 15 ips tapes are rarely if ever brought around to be played, but 3 3/4 ips tapes very often are. In addition, at its lower speed on thin base (1 mil) tape, the maximum recording time is 45 minutes, insufficient to record a complete class or lecture period without a reel change.
Further, the tape recorder was placed uppermost in the rack, where it is impossible to see the control nomenclature without standing on the projector platform. The high position of the recorder in the rack also makes it very difficult to cue up to different portions of a tape.
Furthermore, if a class is being recorder the operator must remember to turn playback level down completely or the output of the recorder will feed back to the classroom causing feedback .
Finally, the signal-to-noise ratio in record mode is very poor, apparently induced by stray fields and poor cable dress within the rack.

C. The four channel mixer installed, a low quality Bogen, does not work on channels 2, 3, and 4 from the mike inputs (no labels) at the stage rear. Whether this is a result of an internal mixer problem or en external cabling disorder has not been determined, primarily for lack of an operating and trouble-shooting manual.

D. The wiring and cabling within the rack is downright shoddy, lending to the previously mentioned hum levels and to confusion in attempting to trace lines in absence of a comprehensive operating manual.

E. A patch board was provided, with no labeling or nomenclature whatsoever.

F. Cue switches were provided for the various audio sources, but they are of the spring return type. An operator needs three hands to hold down a switch and cue up a tape or disc.

G. The Sola power supply for the remote switching relays emits a loud and constant humming buzz, well calculated to set the most placid of operators on edge long before a class is completed.

4. The Projection Booth Arrangement

Recognizing that space is limited, it still must be pointed out that:

A. It is impossible, when showing lantern slides, for an operator to see the rear of the screen panel, the only point at which he can determine focus, while contorted into the position necessary to reach the focus knob on the lantern projectors. When projecting 2x2 slides with the carousel projectors it is possible, but just barely so.

B. An operator projecting slides must be extremely careful not to lean back too far lest he back into one of the push buttons on the rack control panel. This rack positioning means that he must turn 180 degrees from the projectors to turm them on or off, whereas if the rack were turned 90 degrees left it would be in a much more natural position for operating ease. In the present arrangement this would eliminate access to the rear of the rack, but operating layout problems such as this should have been more thoroughly thought out at the design stage. The positioning of the projectors, both still and movie, that is dictated by the rear screen mirror system and the limited booth space in turn dictated by the choice of a rear system, makes the loading and operating procedures extremely difficult, to the extent that film changes during a class, a common occurrence, are often the cause of delay and disruption.

Basically the problem is that the degree of material manipulation (film, tape, and slides) required during a single class period is such that even an operator of high dexterity is prevented from making rapid and smooth changes, ie, it is not valid to assume that all the material to be used in a given class can be pre-loaded and then brought up remotely by the instructor. It has been demonstrated that portions of two or three or more films, several different portions of a tape, etc, are required at different times during a class period, calling for rapid manual changes by an operator. These requirements were almost completely ignored in the layout design of the booth. Granted, the space in the building is limited, but the effect of the rear screen system space requirements on daily operating needs were largely ignored, or, worst of all, simply not understood.

XI-F-11

Report on Harvard Hall

"Giving a lecture in that room is like wearing a shoebox instead of a shoe."

-- lecturer from Nat Sci 130

The following is a list of problems compiled by several staff members of Natural Sciences 130 in regard to Harvard Hall 104. Attached at the end is a student project on Harvard Hall 104. The following report is by no means all inclusive.

1. Technically it doesn't work. (see student project)

2. There is no airconditioning and the windows don't open.

3. The blinds don't cover the windows entirely and it is impossible to get the room entirely dark for projection.

4. The seating arrangement is poorly designed.
   - a. The people on the sides are at an uncomfortable angle in relation to the lecturer.
   - b. The people on the sides are not able to focus in on the rear projection as well as those in the center seats.
   - c. There are not enough aisles and those people who leave the lecture early create a disturbance as well as stepping on a multitude of toes.
   - d. There is not enough space between a seat and the seat in front of it.
   - e. There is not enough leg room for the two people who sit in seats that are adjacent at the transition points from center to side.
   - f. The front row seats are loose. (This may be quite easy to fix.)
   - g. The people on the sides cannot read both side blackboards.

5. It is hard to get both equipment and people up to the camera balcony. (Nearly next to impossible)

6. A ladder place in the aisles is needed to adjust the monitors.

7. The only entry ways into the room are in the front of the hall. Anyone entering late distracts everyone except for the lecturer who, unlike the audience, cannot see the doors.

8. The digital clock was so noisy that it had to be turned off. It was then taped over to prevent people from thinking that is showed the correct time.

9. Problems the lecturer faces.
    a. He can't see the slide, films, etc. that are on the rear projection screens.
    b. The speaker's podium is not suitable -- the notes on it are hard to read because they are not close enough (the podium is too low).
    c. There is no suitable space (other than the floor) for working a local VTR (videotape recorder).
    d. The audience is too low and the lecturer has to talk down to them.
    e. The side blackboard are useless. The lecturer has to stand on the steps leading up to the platform to write on them, in addition to the fact that a third of the audience can't see what's written on them.

10. The room should be better acoustically. It should not be necessary to use a microphone in a room that size.

11. There is no storage area for equipment. Everything must be brought at the start of the lecture and taken back when it is over.

12. The table housing the controls is an obstruction at times.

13. The controls are tied down to the table and cannot be moved more than a few feet (which is all that the table moves).

14. The switches on the control panel are not logical.

15. The chalk tables should either be eliminated (and a storage space provided) or extended.

16. The room is aesthetically unappealing -- the space is broken into awkward shapes with its width greater than its depth.

XI-F-13

David J. Berman
N. S. 130
section--W. Schroeder

THE AUDIO-VISUAL INSTALLATION AT HARVARD HALL 104

THE AUDIO-VISUAL INSTALLATION AT HARVARD HALL 104

David J. Berman

I. Introduction

During the 1968 renovation of Harvard 104, an elaborate audio-visual facility was installed, consisting of equipment for the recording and reproducing of audio material, the reproduction of video material, and the rear-projection of 2x2 slides, Polaroid lantern slides, and 16 mm motion pictures with optical sound track. The equipment is controlled from a lecturer's console located on the stage, or from an operator's console in the equipment room behind the black-boards.

II. Audio System

A. Sources

Eight audio sources are provided, any of which may drive the two KLH 6 loudspeakers through the 60-watt amplifier.

1) the audio output of the TV demodulator, which can be used to receive signals from local TV stations or from the Harvard Information Transfer System.

2) the reproduce amplifier of an audio tape recorder that can play half- or full-track tapes at speeds of 7 1/2 or 3 3/4 inches per second

3) a turntable that can play stereo or monaural records at 33 1/3, 45, or 78 RPM

4) a microphone mixer that controls the lecturn microphone and

the baseboard microphone inputs

5) the audio output of 16mm projector #1

6) the audio output of 16mm projector #2

7) the audio output of a video-tape-recorder that is not yet installed

8) a telephone line that is not yet installed

B. Patch Bay

The audio lines from the sources are all terminated in a patch bay of the type used in broadcast and recording studios. This patch bay uses the popular "normal-thru" wiring scheme which means that each source has two jacks corresponding to it, the first being the output of the source, the second being the associated input to the amplifier. Thus, if a patch cord is inserted into the first jack, the source output goes not into the amplifier but into the patch cord, and if a patch cord is inserted into the second jack, the amplifier takes its input not from the source, but from the patch cord. If there is no patch cord, the two jacks are connected together, which is the normal condition. The jack numerical designation is as follows:

	source output	amplifier input
1) TV demodulator	1	2
2) audio tape recorder	5	6
3) turntable	7	8
4) microphone	9	10
5) 16mm #1	11	12
6) 16mm #2	13	14
7) audio output of VTR	3	4
8) telephone line	15	16

C. Cue System

It is often desirable for an operator to "cue up" a program source so that as soon as he or the lecturer calls for it by pressing the appropriate "start" button, the material will start without delay. To accomplish this, a separate cue amplifier and speaker are provided, along with switches on the equipment rack that, when pressed, divert the output of the associated source from the main amplifier into the cue amplifier. Thus, the operator but not the audience hears the material. The sources that have cue switches are the TV demodulator, the VTR, the audio tape recorder, the turntable, and each 16mm projector. Also on the equipment rack is a four-position cue mode selector. Position #1 inactivates the cue system, #2 is the normal operating position for cueing, #3 sends the output of the microphone into the cue speaker whether the microphone is turned on or not, allowing the operator to hear the lecturer, and #4 sends whatever is going over the main amplifier into the cue amplifier also.

D. Main Amplifier

In regard to the main amplifier, two points deserve mention. First, on the patch bay are located a pair of normal-thru jacks associated with the main amplifier. Jack #21 is the output of the switcher that feeds the amplifier, and #22 is the input to the amplifier itself. Second, the only master volume control on the system is a step-type attenuator located under the right-front TV monitor. This attenuator is in the output of the main amplifier, and therefore if the amplifier is being overdriven and is consequently distorting, reducing the level with this control will not help.

E. Audio Tape Recorder

The input circuit of the recorder is connected directly to the output of the microphone mixer, whether or not the microphone is turned on. This set-up is designed primarily to record lectures. However, there are two normal-thru patches that may be used to record other program meterial. Jack #17 is the output of the microphone mixer, and jack #18 is the input to the recorder. Also on the equipment rack is a record-play toggle switch. Normally left in "play" this switch must be thrown to "record" before the lecturer can initiate the recording by pressing the play and record buttons on his console. When in"record," this switch also cuts out the tape recorder output to eliminate the possibility of echo.

F. Connecting other sources

It is often necessary to connect an external program source, such as a VTR, to the main amplifier. The source must satisfy two requirements, 1) it must have a high level or "line" output, and 2) it must operate satisfactorily into a 600-ohm load. The external source can be patched into the system via the direct connection to the main amplifier, jack #22. One must bear in mind, however, that since this breaks the normal-thru, no other source will play through the amplifier unless the patch cord is removed. A better idea might be to patch the external source into the VTR input or telephone line input and then merely turn the input on at either the lecturer's or operator's console. This way, the other inputs in the system are not disabled.

III. TV System

There are four sources of video material that can be selected for display on the four monitors in Harvard 104. Pressing "desktop visuals" on the lecturer's console floodlights the lecturn and feeds the output of a camera,located in the ceiling above the lecturn to the monitors. Thus, items placed on the right side of the lecturn are displayed on the monitors. By manipulating a control on the console, the camera lens focus and "zoom" can be adjusted. Pressing "overhead transparencies" turns off the floodlights and turns on an overhead projector located under the right side of the lecturn. Thus transparencies can be displayed on the monitors. Pressing "Harvard Television Network" feeds the output of the demodulator to the video monitors and audio amplifier, thus material from the Information Transfer System or from local TV stations can be shown. Pressing "Videotape" feeds the output of a not-yet-installed VTR to the video monitors and audio amplifier; these inputs can be used as spares.

IV. Rear-projection

The projection controls on the lecturer's console are self-explanatory. Either 16mm film, lantern or 2x2 slides can be displayed on the left screen, lantern or 2x2 slides on the center screen, and 16mm film on the right screen. Forward and reverse sequencing controls are provided for both 2x2 slide installations.

V. Lights and miscellaneaous controls.

The room lights are controlled by four switches on the lecturer's console. The leftmost switch controls the stage lights, and must be pushed diagonally. The two middle switches control the direct flourescent room lights, and the rightmost switch controls the indirect lighting at the side of the room. Whenever a projection unit is turned on, the necessary room lights are automatically turned off.

Also located on the lecturer's console is an operator call button that rings a bell in the equipment room, and a button that turns all the equipment off, called the "all equipment off" button.

VI. Bugs

Sounds great, doesn't it? Well, unfortunately not all systems are go. A general criticism is that although the panel itself was constructed neatly and sturdily, the cable that connects the lecturer's panel to the system is connected extremely poorly and sloppily at the lecturer's panel. This may be the reason for some of the system's faults, of which several are as follows.

1) When any audio device is turned on, the videotape control relay pulls in, which turns on the TV monitors. This may be due to a faulty ground connection or isolating diode.

2) The cue amplifier doesn't work. Investigation revealed a burned-out tube. This should be replaced immediately if possible.

3) There is no 16mm projector for the left screen, and no 2x2 slide projector for the center screen, although provision is made for both of these.

4) The "forward" sequencing button for the left-screen 2x2 slide projector doesn't work. Investigation revealed this to be a fault with the system, not the projector.

5) The TV system cannot receive local stations, probably due to the lack of an antenna.

6) The lecturn microphone has never been replaced after being stolen.

7) The overhead transparencies unit was damaged, and has not been repaired.

8) The lights in the "desktop visuals," "overhead transparencies," and "all equipment off" positions are inoperative, and not all of them are burned out.

9) The toggles for two light switches and the ceiling camera control are missing.

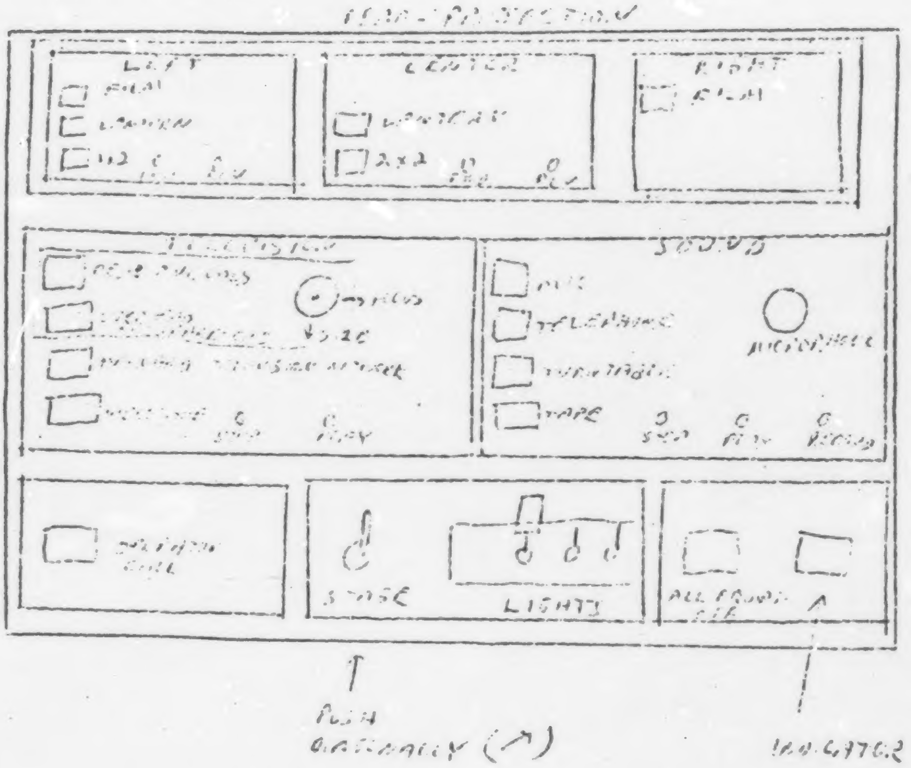
10) Occasionally no audio comes from the turntable. Investigation

revealed the problem to be in the phono preamp, perhaps in its individual power supply.

11) The operator call signal doesn't work, but it is not clear if that is a desirable item anyway.

All of these problems appear to be reatively simple, and could probably be fixed with little difficulty.

DIAGRAM OF LECTURER'S CONTROL PANEL


REAR-PROJECTION
LEFT
FILM
LANTERN
CENTER
LANTERN
2x2
RIGHT
FILM
SOUND
MIC
TELEPHONE
TURNTABLE
TAPE
STOP
PLAY
RECORD
MICROPHONE
STOP
PLAY
OPERATOR CALL
STAGE
LIGHTS
ALL FRONT OFF
PUSH GRADUALLY (↗)
INDICATOR

APPENDIX XII

Annotated Proposals

APPENDIX XII-A

1969 Proposal

ANNOTATED 1969 PROPOSAL

II. Description of Proposed Research

A. Objectives

The recent past has seen a great upsurge of interest in educational innovation and particularly in modern technological devices intended to supplement or supplant conventional chalk, blackboards, and books. We believe that, with few exceptions, the net effect has been the introduction into static environments of isolated pieces of expensive equipment that are used little if at all, that are misused more often than used well and that have had only the slightest effect on the quality of our nation's education

Yet the hope remains that the great potential of modern technology can be realized in order to help solve the major national problem of educating and training a rapidly growing population at all levels from the most elementary through the most advanced to continuing adult education.

We hypothesize that the combination of ill-designed, untried or unreliable technology, of absent or untested content and of ill-trained and unmotivated personnel working in institutional contexts almost ideally adapted to resist change may account for this failure or at least may preclude scientific probing into its causes and an imaginative search for remedies.

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NSENSE

We therefore propose to determine the real potential of an appropriate gamut of educational media in a laboratory situation where political and institutional problems are minimized and where the choice of equipment and of the pattern of instruction can be made to flow logically from the intellectual structure of the material to be presented and the capabilities and needs of students. ONLY SMALL PROGRESS IN UNDERSTANDING. BUT, GREATER UNDERSTANDING OF WHAT VARIABLES ARE CRITICAL – MAIN THRUST OF REPORT

We propose a test in which curriculum development, the choice and the integration of technique and equipment and also actual classroom teaching are all done by one and the same group thereby decreasing the frictions and noises which otherwise tend to mask the effects being evaluated.

By conducting our experiment in the framework of a university which encourages freedom and initiative on the part of its teachers, we hope to minimize, although by no means to eliminate, the institutional constraints which tend to restrict curricular innovation. By choosing as our experimental vehicle a course on the study of communication, we hope to create a situation in which the teaching process itself becomes a legitimate object of study, thereby enabling us to deal with students whose understanding of the media that are being tested should be well above average. If such students are unable to use technological innovations effectively (and to criticize them), the odds of others doing so seem considerably slimmer. By keeping in close touch with industry at all stages of our experiment, we expect to retain a sense of practicality while also exerting some pressure on industry's

+, BUT THERE ARE CATCH-22'S. SEE PASS/FAIL DISCUSSION

OK

IN RETROSPECT: PRO: ACHIEVED GLOBAL VIEW OTHERWISE HARD TO COME BY
([illegible] OETTINGER ZAPOL 1972; APPENDIX I-B)

CON: TOO BIG A BITE FOR ISOLATED PROFS., EVEN
(OR ESPECIALLY??) AT HARVARD

definition of the practical and the economical.

DONE - SEE APPENDIX VI, esp. B, C

Responsibility for the failure of rapid acceptance of technological innovation in the schools may be ascribed not merely to hardware or software failures but also to the limitations of school personnel, school institutions and their social context. We believe that if this observation is valid, then our course should be aimed primarily at students from the humanities, the social sciences and the School of Education and designed to impart to them both an understanding of language and communication and enough actual command of scientific method and technological skills to mitigate the alienation from science and technology now so prevalent in a majority of the college population. This alienation propagates itself, since teachers ignorant of and therefore either hostile to or overawed by science and technology breed like-minded students. Our course will, if successful, break the vicious circle of hostility or awe by helping to channel into the teaching profession and into management and policy making positions at all levels of industrial, government, and academic life, students with a command of science and technology and with a conviction that these human and humane activities have human relevance that will enable them to make or to evaluate plans for technological innovations with far greater insight and rationality than are being applied nowadays.

SEE APPENDICES III - V

Our goals are first to specify the content and then to develop the techniques for teaching such an experimental course; one objective is to conduct and evaluate this experiment so as to shed light on the conditions that have made it a success if so it be, or else so as to pinpoint the intellectual, technical, or institutional problems to which partial or total failure can be ascribed. In either case, we plan to keep detailed systems design and cost records that should help others either to follow our footsteps or to avoid our mistakes.

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DONE WITH SIGNIFICANT PROGRESS

DONE IN PART - SEE APPENDIX XI A-C, OVERWHELMIN

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The record will be used in conjunction with the results of a study of educational technology now being directed by one of the principal investigators under the auspices of the Harvard Program on Technology and Society*.

1) to reach conclusions concerning the relation between content and technique and the relation between the effectiveness and and cost of teaching aids

2) to examine the social and institutional contexts that aid or hinder the widespread application of educational technology

3) to formulate recommendations for policies to be followed by educational, industrial and government institutions if technological innovations are to improve education on a national scale in proportion to whatever real merit they are found to have.

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*This research group includes Anthony G. Oettinger, Don Meals (Raytheon Educational Division), Sam Nash (Director of Special Projects and Program Planning, New Haven Schools), and Howard Gruber (Institute for Cognitive Studies, Rutgers University).

1. Course Content and Objectives

The working title of the course chosen as an experimental vehicle is "Communication in Men, Animals, and Machines" (Appendix 1). We see it as addressed to an audience of bright college sophomores or juniors who are not necessarily majoring in biology, linguistics, mathematics, or computer science.

We wish to impart an understanding of the fundamentals of communication and its effect on relations among individuals and on the organization of societies. Since both the practice and the study of human communication have always been deeply influenced by available technology, we can lead naturally into explorations of the vital relation between technology and society.

Y OF
EPORT
ENDIX I, II

Communication of some kind is fundamental to the survival of species from the lowest to man and ranges from elemental mating behavior to the abstractions of humane scholarship and science. We plan to study both the phenomena and the tools of communication in a kind of spiral progression beginning with the presentation of raw observations (e.g. of ants searching for food and laying trails back to the nest for others to follow, of frog mating calls, of a telephone conversation from the vocal tract of the speaker through the telephone network to the eardrum of the hearer, of our classroom itself, of man-computer interaction, etc.) and ending with the biological, linguistic and mathematical abstractions now in vogue as theoretical accounts of these observations.

ENDICES
-V

One of our goals is to impart an understanding of these phenomena and these tools to our students. Different levels of our spiral correspond to different levels of symbolic abstraction and the explication of the notions of symbol representation and symbol manipulation is to be both a basic thread tying our exposition into a whole and another goal. Given motivation to understand the pervasive phenomena described at the lowest level of the spiral, the goals of understanding the technology that mediates these phenomena in human societies and the scientific thought that illuminates them are spread as way stations up along the spiral as we look at the same phenomena over and over again each time through increasingly abstract and general models and from an increasing number of points of view.

Everywhere along the spiral, we see branches leading to special presentations or special projects that can provide for variety over the years and for individual exploration, specialization and mastery in depth for students with the initiative to pursue specific interests. Since these presentations and projects can be molded to a variety of talents and backgrounds, our goal of having students live science and technology, at least to some extent and not merely hear about it may be attainable.

In the process, we hope to leave even the most humanistically oriented student not only with an insight into science and technology and the conviction that these activities have human relevance, but also with a sense of ability to master their techniques and to understand their practitioners.

To the extent that our students become the teachers, the managers and the policy makers of tomorrow, this may be our most important goal, since we believe that little significant change can take place in the nation's schools until universities and schools of education themselves become responsive to change and begin to supply to industry, government, and the schools a new breed of personnel neither awed by nor hostile to technological or institutional change and imbued with the self-critical and open-minded spirit that characterizes science at its best.

BODY OF REPORT
APPENDIX II,
APPENDICES III-V

We choose to concern ourselves initially with those aspects of communication which have clearly lent themselves to successful scientific study. We propose to guide students in direct observation of natural linguistic phenomena, in concrete laboratory experimentation (e.g. clay lends itself more naturally to cuneiform than to cursive writing) and in vicarious but nonetheless vivid exposures to reality through films and other media. At the same time, we expect to develop enough mathematical tools to enable the students themselves to practice distillation from experience to theory, abstract theoretical manipulation, and the confrontation of theory with reality. Laboratory sessions (real and simulated), field trips and problem-solving opportunities therefore are to be an important facet of the course.

Once the course is developed, we plan to offer it initially under the auspices of Harvard's General Education Program in the hope of attracting primarily students from the humanities, the social sciences and the School of Education and of imparting to them not only an understanding of language and communication but also enough actual command of scientific method and technological skill to mitigate the alienation from science and technology now so prevalent in a majority of the college population. Since the same alienation and misunderstanding prevalent also among management personnel and policy makers of all levels of industrial, government, and academic life, we consider the proper education of students who will join their ranks in the future as an important national responsibility.

MILD EFECT
(APPENDIX
VI-C)

We shall not be unhappy if we also attract some science majors or stimulate the others to delve more deeply into the subjects to be introduced in this course in a fashion that we hope will be far less repelling than in the conventional introductory mathematics, computer science or linguistics courses.

The broader significance of our effort is discussed in Section C (Use of Findings).

2. Method

All three of the principal co-investigators have had extensive experience in the use of computers for both research and instruction. We have also experimented with the use of live and closed-circuit television, slide/tape sequences, films, and other media in the classroom. The experience has left us profoundly unimpressed with glowing hopes for a quick "technological fix" for the national problems of education. Total dogmatic commitment to the ideological virtues of individual instruction or the economic advantages of canned conventional lectures ignores the grave shortcomings of either extreme. Blind partisan advocacy of the miraculous virtues of any single gadget, be it the computer, television, or the notion of programmed instruction seems seriously misguided to us. The catchy phrase "multimedia approach" leaves unspoken the hideously irritating problems arising in an environment where chalk squeaks, tape projectors won't thread, slide feeds jam, computers do not respond promptly or get thrown out of action by the slightest operating error, etc. Experience tells us that even the "systems approach" to major enterprises is often no more than a pompous and pseudo-scientific application of the simple notion that it is better to think about a problem in its full context than not.

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III - V

We want to start with what we want to say. The question then is how best to say it. Where chalk on a blackboard will do, that's what we'll use. Where we believe a computer-driven oscilloscope display to be the best way to get an idea across, we'll turn to the computer and likewise for programmed instruction and other media.

Since we wish to provide more than the vicarious experience of a "communication appreciation course", the design of laboratory exercises where students and their instruments can confront nature in a realistic way becomes very important. Where it is best that nature speak directly to students or students directly to each other, the instructors must be silent.

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PRESSURES

A very rough and unintegrated outline of proposed course content is given in Appendix 1. Aside from being ill-organized, the outline in its present form is both too ambitious in its scope and full of sins of omission. It also still reflects our own difficulty in shaking off conventional thinking about content and order of presentation, thinking constrained by both intellectual tradition and accepted university teaching conventions (e.g. three one-hour lectures per week). For example, the "spiral" of II A 1 is not in evidence in Appendix 1. We have not yet thought enough about distinguishing essentials from interesting frills. We have indicated only in the roughest way what tools and techniques we think apply to various demonstrations or laboratory exercises.

We have not yet thought about how much of the content should be imparted through lectures, how much through individual conferences or small group interactions, how much canned, how much live, how much programmed, how much unstructured. These are questions we wish to investigate.

We believe that we have unique assets in our combination of mastery of the content to be transmitted with experience as college teachers and as investigators of various aspects of educational technology. We hope that this vertical integration will enable us to avoid the misunderstandings and false steps inevitable where those who plan course content, provide materials or organize media and those who must teach are not one and the same.

BODY OF REPORT
APPS III - V
APPS IX, X

We wish to test our belief that teaching techniques and equipment not only should but can flow logically from the intellectual structure of the material to be presented and not vice-versa as is so often the case now. We plan to specify content, examine how best to present it, devise appropriate organizational and scheduling techniques, assemble and edit necessary materials, specify the necessary apparatus, borrow, rent, design and order it, or build it where necessary, engineer interfaces, and go through these steps as often as necessary to orchestrate the whole into a harmonious, smooth and reliable performance where each medium participates because it has something to say and not merely because it's there. If we fail, much more elaborate failures in less favorable circumstances may be forestalled. If we succeed, the politics of introducing innovations can be played with much greater assurance than there is now that the game is worth playing.

Since the course is about language and communication, it has a convenient self-referential quality such that the experience of participating in it itself imparts content to the student. Thus, the fiascoes inevitable in the first tests of the course should themselves be illuminating experiences for the students, since the course lends itself to frank analysis of the problems rather than mere sheepish apology. As the course improves, we hope to increase its depth and smoothness while losing as little as we can in spontaneity.

BODY OF REPORT
APPENDIX
VI-C

We have puzzled a good deal about the size of the group at whom the course is to be aimed initially. While student reaction to such an offering is hard to gauge beforehand in a free market, it seems reasonable to expect that somewhere between 75 and 150 students would elect to come the first year. Whether the number is in fact larger or smaller is not too significant as far as lectures go, since technique, space, and staff adjustments are not very critical in this case.

What complicates matters is our thinking that opportunities for laboratory experience, extensive problem solving, individual contact, and small group interactions have a vital role to play in testing our hypotheses about the merits of both content and technique. Yet, we are not foolish enough to believe that we now can handle the immense problems of providing for meaningful individual instruction (either automatically or on two ends of a log) on any scale involving more than, say, 10 or 20 students.

If we lecture to many less than 100 students, the per capita investment in the course will look even more preposterous than it inevitably must in any experiment. If we plan laboratory sessions, etc. for many more than 10 or 20 students initially, we and they shall fall flat on our faces.

The compromise we now envisage, subject to revision in the cold light of further experience, is to permit some of the students in the regular course to enroll in a much smaller, concurrent course under rules that permit Harvard undergraduates to engage in independent study. These students would have essentially free access to all of the facilities developed for the regular course and they would be expected to work much more intensively than the others as individuals, as a small group, and with extensive guidance by the human and mechanical staff.

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B. Description of Activities

We expect the project to proceed in three stages. The present proposal is for the first stage only.

STAGE 1. Preliminary investigations and Course Planning. July 1, 1968 to June 30, 1969

During this time, we should like to rework our course outline, particularly in order to free it from the conventional constraints that still shape it. We also wish to make a preliminary investigation of the range of available films, videotapes, slide sequences, instruction programs, laboratory gear, books, etc. already available. This is essentially a bibliographic search but in an extended sense.

Next, we expect to organize the course content in great depth and detail. Refined estimates of materials necessary to conduct the course will be prepared. Materials already available will be examined and edited or otherwise adapted to our purposes. New materials will be planned and prepared as necessary. However, we would prefer, insofar as possible, to defer any major direct or commissioned production of movies, etc., since we see the integration of reliable techniques as one of our major initial problems. Technical facilities will be planned and specified. It is vital at this stage to explore techniques for easy and smooth actuation and coordination of movie and slide projectors, computers, programmed teaching devices, CCTV links between laboratories, the Computing Center, WGBH and the classroom, etc. so that a smooth, uninterrupted flow can be maintained in lecture, and so that spontaneity in discussions of problem-solving sessions can be achieved without catastrophic distintegration of the whole complex.

Auxiliary facilities for grading, record keeping, advising, bibliographic services to students, dictating, secretarial help, TEXT90 (text editing) facilities, etc. will be planned.

SEE APPENDIX I-A.
OPERATIONAL PRESSURES LED TO SIGNIFICANT RELIANCE ON OUTSIDE MODULES, e.g. HEAVY USE OF SCIENTIFIC AMERICAN REPRINTS

At this stage, the division of the course into free standing modules or units that may be suitable for concurrent or future dissemination to other colleges or secondary schools will be explored jointly, where appropriate, with industrial organizations in the publishing or educational technology fields.

While we expect to emphasize direct experience (laboratory, field trip, video-tape or movie) and problem-solving behavior (for easy access to computing, etc.) and encourage spontaneity, we can expect only chaos without the most careful planning.

MIX - STUDENT REACTIONS ON THIS SCORE

VERY INTERESTING (MAIN BODY OF REPORT)

NOT DONE

MAJOR JOB IN ITSELF WHERE CONTEXT CAN BE HELD STATIC

We hope to turn to programmed instruction where it might help get across basic principles or concepts and impart elementary skills. To help foresee the interaction of various technical devices while students are exposed to various types of content, and hence to help plan for smooth flow, detailed scenarios will have to be prepared for lectures and even for laboratories. We consider the problem of coordinating content and technique and of interweaving varied techniques smoothly and reliably to be a major present barrier to the wider acceptance even of existing educational technology. Unless these problems, now largely ignored, can be overcome we see little hope for any but the most pedestrian and peripheral use in the classroom of advanced technology at any price.

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The following two stages are not included in the present proposal.

STAGE 2. First round of teaching and preliminary evaluation. (July 1, 1969 to June 30, 1970).

In this version the course may be regarded as being in a breadboard stage of design. The efficacy of content will be tested through class reaction; equipment smoothness and reliability can be assessed.

During the summer, a group of teaching assistants will have to be trained both in content and in technique. Dress rehearsals based on the scenarios developed in the preceding year must be held to debug the principals, their assistants and their equipment.

STAGE 3. Second round of teaching; evaluation, and dissemination. (July 1, 1970 to June 13, 1971).

The breadboard should have most of its obvious bugs chased out by then, and one product of this second year will be either design for an elegant version both of the content and of the apparatus or a thorough account of the reasons for partial or total failure.

During this period we will put in final form our conclusions concerning the relation between the effectiveness and the cost of teaching aids, our examination of the social and institutional contexts that aid or hinder their widespread application and our formulation of recommendations for policies to be followed by educational, industrial and government institutions if technological innovations are to improve education on a national scale in proportion to such real merit as they are found to have.

C. Results

The long-term results of our study should fall into five major categories:

1. Description of the design process.
2. Course content.
3. Cost Analysis and Policy Recommendations
4. Dissemination of course and laboratory units.
5. Equipment designs and realizations.

The first phase, to which this proposal is addressed, will result primarily in detailed definition of course content and better estimates of resources required if the course is indeed to be given with the aid of unconventional techniques.

1. Design Process. We expect to keep a detailed record of intellectual, institutional, and financial events on the path taken toward design decisions affecting both content and technique. In an area where there are now only the vaguest guidelines for systems design, this record should be valuable to others who wish either to follow our footsteps or avoid our mistakes. If we are successful, this record in condensed and critically evaluated form should lead to conclusions concerning both effectiveness and cost that can help others interested in following similar design procedures aimed at different content objectives. If we fail wholly or in part, this record should be of great value in assessing where our basic conceptions of content or method were at fault or where and why our hardware/software and interface specifications or design were inadequate. The influence of institutional factors will also be considered. A careful record of this kind should be of much value to future designers who can now choose only between grandiloquent but unsubstantiated promises and bitter Luddite invective.

SIGNIFICANT RECORD AVAILABLE

One danger inherent in the use of extensive and expensive technical devices is the freezing of content and the loss of both spontaneity and timeliness as the years march on. This phenomenon is clearly evident in the preparation and use of textbooks, and it may well be aggravated by other devices. We see the concept of the central spiral with branches described in II A 1 as one possible way to alleviate

TREADMILL MOVES TOO FAST. (SEE ROTHKOPF, E.Z. "A Proposal for Documenting Faculty Enterprise: Institutional Memories for Courses to Foster the Growth of Science Instruction and to Assure Instructional Quality, Unpublished, Bell Labs. 1972.

this problem. However, we plan to pay explicit attention to this question throughout our design and implementation steps, and to report not only findings on initial development problems, but also findings about the maintenance and updating procedures necessary to assure flexibility, individuality and timeliness. The cost of such procedures will be determined or estimated.

2. Course Content. A possible conclusion at the end of the proposed first study stage is that the course be given in a conventional way without additional outside support.

If a less orthodox approach is adopted, then, after stages 2 and 3, its success or failure in terms of speed and depth of content acquisition, and reliability may very well be obvious from the most casual observation. If success is clear in Stage 2, special care can be taken during Stage 3 to prepare the finished design in a manner appropriate for easy dissemination to other universities or secondary schools. We plan for early and sustained collaboration with industrial organizations, embryonic inter-university networks and local schools to aid this process.

Obvious failure in early phases would naturally lead to a painful choice between dropping the matter altogether or going through later phases with whatever changes may be necessary to replace unsuccessful approaches either with modified approaches still in the general spirit of this proposal or with conventional approaches to portions of the content.

Should we fall into the unpleasant gray area where failure is not obvious but the value of educational return in comparison with the investment is not clear either, essentially the same judgments will have greater pain and less certainty. The fact that the course will compete for student interest in an essentially free market serving a capable, critical and uninhibited clientele is a distinct asset in these straits.

In any case, our place for both content and appartus would lead to such major departures from any reasonable norm that we see no prospect for any worthwhile formal statistical analysis at this stage. If outside observers agree with us that the experiment is reasonably successful by their subjective standards, it may then be worthwhile to design to lend these judgments greater objectivity. We shall, of course, plan to prepare figures such as developmental costs and projected instruction costs per student in the steady state. Since these will most likely be outlandish by any present standard, no amount of statistical juggling can circumvent the eventual need for bold decision concerning whether or not the game is worth the candle.

3. Cost Analysis and Policy Recommendations. The policy decision mentioned at the end of §2 is not a simple one. Most likely the

present costs of widespread use of major technological aids to instruction are beyond the budgets of conventional universities. Several possibilities immediately present themselves beyond the obvious one of dropping the whole subject.

a. The federal government could elect to undertake a massive subsidy program for this purpose.

b. Major organizational changes in universities and their teaching practices could lead to cost reductions.

c. The costs of some if not all of the technological aids could drop as they move from innovation toward mass production.

d. Shared regional facilities or industrial services could lead to unit cost reductions.

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Our experience in the design process doubtlessly will suggest others. We plan to study these possibilities and, unless none seem useful under reasonable assumptions concerning the future and the goals of education, to develop recommendations for a course of action likely in our judgment to foster the useful integration of technological aids into universities at a cost commensurate with the value of the effect as best as we can assess it.

One part of this cost study will focus on the development of appropriate cost accounting techniques, with our own costs serving as a benchmark. Direct and indirect cost components that should be monitored must be identified and the burdens of keeping cost records in teaching environments of the present and the future must be evaluated.

Although our analysis will deal chiefly with universities, we believe that if they and schools of education can come to terms with this problem, the flow into the teaching and administrative ranks of students themselves exposed to new modes of education will have a deeper and more valuable effect on secondary and elementary education in the long run than attempts to combine an untried technology with untested content for the use of ill-trained and unmotivated personnel under institutional conditions now almost ideally adapted to resist change.

Given our assessment of technical and cost factors, we plan to combine the experience gained from this experiment with the results of a study of educational technology now being directed by one of the principal investigators under the auspices of the Harvard Program on Technology and Society in order to

1) Develop some general conclusions concerning the relation between content and appropriate techniques and the relation between the effectiveness and the cost of teaching aids

See p2

2) Examine the social and institutional contexts that aid or or hinder the widespread application of educational technology.

3) Forumulate recommendations for policies to be followed by educational, industrial and government institutions if technological innovations are to improve education on a national scale in proportion to whatever real merit they are found to have.

DONE INTERNALLY

NO RESULTS [illegible] (Except materials in Appendix I-A)

4. Unit Dissemination. While our goal is the development of a meaningful course in which content and technology are harmoniously interwoven, we shall, as described in section B, make every effort to produce modules that are self-contained both in terms of content and apparatus so that, if the course is successful, later editions may be varied through the easy substitution of new modules for old. Whether the course as a whole is a success or a failure, we hope that individual pieces will be successful enough to merit distribution and use in college or secondary school courses whose general intent may be different, but where there is some measure of content overlap. To such extent as circumstances permit, we expect to experiment in this respect with both the embryonic inter-university networks and local secondary schools.

5. Equipment. As far as equipment is concerned, if we are successful, the design prepared in stage 3 would be available for replication *ad libitum*. If we fail, the record described under (1) should provide sufficient clues to prevent repetition of similar failures and to guide other designers in universities or industry toward more successful designs. Collaboration with industry should help in either process.

III. Personnel and Facilities

A. Personnel

1. Principals	STAGE 1 1968/69
Anthony G. Oettinger* (Prof. of Linguistics and Applied Mathematics)	1/2
William Bossert* (Asst. Prof. of Biology and Applied Mathematics)	1/2
Susumu Kuno* (Asst. Prof. of Linguistics)	1/2
Lawrence Stolurow* (Lecturer on Education, Associate of the Harvard Computing Center)	1/4
Sema Marks	1

*Detailed biographics appended (Appendix 3)

2. Consultants

   a) Tentatively Committed

      Professor Ivan Sutherland - Harvard (Arts and Sciences)
      Professor Hubert Dreyfus - M.I.T.
      Dr. Donald Meals - Raytheon (Educ. Division)
      Dr. E. E. David & staff - Bell Telephone Laboratories
      Mr. Thomas Bartee - Harvard (Electronics Design Center)

   b) With known specific interest, but not yet formally approached regarding participation

      Professor Douglas Porter - Harvard (School of Education)
      Mr. Richard Oldham - WGBH-TV
      Mr. Robert Gardner - Harvard (Carpenter Center for the Visual Arts)
      Mr. Kevin Smith - ESI/EDC
      Mr. Charles Eames
      Mr. Austin Lamont
      EDUCOM

   c) Colleagues associated with the Harvard Program on Technology and Society, the Graduate School of Education, the Economics Department, etc.

3. Assorted assisting staff

B. Facilities (Raw material)

   a.) Computers

      1. TACT On-Line Computer (TOC) (instructional system being developed under ARPA contract SD-265 - Appendix 2)

      2. 7094's, 360/50 etc. at Harvard Computing Center

      3. PDP-1 with extensive display facilities (ARPA SD-265)

      4. SDS-940 with remote teletype consoles

   b.) TV etc.

      1. Network TV, Videotape and complete studio facilities at WGBH

      2. Local CCTV facilities (Harvard - wide coaxial cable network, linked to WGBH)

      3. Professional film animation table and camera (Visual Arts Center)

      4. Filming facilities (rentable from ESI, Austin Lamont and other local consultants and firms)

c.) Laboratory Facilities

1. Insectary at Biological Laboratories suitable for maintaining communities of ants to be observed in trail-laying communications, etc.

2. Sonograph (MIT), Vocoder (Air Force Cambridge Research Labs.), Speech Synthesizer etc. (Bell Telephone Laboratories) etc.

d.) Lecture Halls, etc.

Several Harvard lecture halls and laboratories have appropriate wire terminals. Detailed space and equipment requirements to be laid out in stage 1.

e.) Relevant Software

1. TOC system (ARPA SD-265)

2. Predictive Analyzer of English: The program accepts English sentences as input and produces syntactic analyses of the sentences. The dictionary contains some 20,000 words, and the grammar contains some 3,000 syntactic rules for English.

3. Phonological Component of Transformational Grammar: The program accepts as input an English sentence in a phonological representation, and outputs its phonetic representation. It has been developed for testing Chomsky-Halle's phonological rules of English, but the user can write his own rules and test them on a console.

4. A Tester for a Transformational Grammar: The program is designed so that a linguist can test his transformational grammar on a console rule by rule and can follow derivations of sentences step by step.

5. TEXT90 text editing system

6. Miscellaneous mathematical biology and mathematical demonstration programs.

7. Etc.

APPENDIX XII-B

Annotated 1970 Proposal

ANNOTATED 1970 PROPOSAL

I. INTRODUCTION

Oettinger & Zapol
1972
Hepner 1972

Exploring the relationships between what is to be taught or learned and the people, processes and media best suited to doing so remains at the intellectual core of our objectives. The abstract of our proposal for the now on-going exploratory phase of work (Appendix 1) therefore remains a valid statement of our general outlook and plans.

During the five-month period since our NSF grant began on July 1, 1969, we did a series of rough experiments. These are described briefly in Section II of this proposal and in more detail in an accompanying Preliminary Report. In the light of these experiments we also translated the general aspirations of our original proposal into the more concrete and specific plans for 1970-71 described in Section III of this proposal.

Since our original proposal was submitted in February 1968, plans have matured for the inclusion of a teaching development laboratory and related facilities within a Harvard Science Center whose construction was authorized by the Harvard Corporation in October 1969. Doctoral work explicitly centered on educational technology has emerged under the guidance of the principal investigators, who are currently supervising four graduate students in this area. Three of these are under the Division of Engineering and Applied Physics of the Faculty of Arts and Sciences and the fourth is under the School of Education. Harvard and MIT have jointly created the University Information Technology Corporation (UNITEL). The common exploitation of new educational technology of libraries and of computing facilities is UNITEL's principal objective. The principal investigators also collaborated with a study of interactive communication over distance (International Electronic Highway) made by the WGBH

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SEE APPENDIX XI, 2ab, [illegible] XI [A-D

Educational Foundation for the Ford Foundation. They have assumed a share of the administrative responsibility for the Harvard University Broad Band Information Transfer System. The influence of these and other recent developments on our long-range aspirations is discussed in Section III.

II. CURRENT ACTIVITIES

Our experiments since July 1, 1969 have dealt with only three of the common instructional processes: the classroom lecture, concentrated personal interaction between a professor and a single graduate student, and a variant of computer-aided instruction involving a student and an interactive computer terminal. The media being considered included chalk and blackboard, a variety of printed materials, lantern slides, some special demonstration devices and THE BRAIN, a time-shared interactive graphic terminal system developed by Project TACT under an earlier contract with the Advanced Research Projects Agency of the Department of Defense.

There were two separate lecture situations, each involving the injection of new experimental presentations into an otherwise conventional course. In one case, a series of four experimental lectures on the elements of statistics was substituted for the conventional lectures on the same subject given by Oettinger in several previous editions of an introductory undergraduate course on Computational Linguistics. The whole gamut of devices mentioned in the preceding paragraph was used. In the second case, Bossert substituted the graphical display of solutions of differential equations depicting the dynamic characterist of populations of competing species for a teletype-based lecture demonstration he had previously used in an undergraduate course in Evolutionary Biology.

The preparation of the statistics lectures was a collaborative effort of Oettinger and Maury Hepner, one of the candidates for the Ph.D. in Educational Technology. The aspect of this experience directly relevant to our experiments is the comparison of what both participants learned about statistics and how they learned it while preparing for lectures, with what happened in class and how it happened there. Andres Zellweger, another of the Ph.D. candidates, has developed a semi-programmed sequence of instruction on the use of THE BRAIN itself. Materials and processes are now ready, but experimental use is only beginning so that results are not yet available. Robert Dirkman of Merrimack College, now at Harvard on an NSF Science Faculty Fellowship is beginning to prepare some materials for experimental instruction in electrical network theory.

Details of these experiments are reported in part in the accompanying Preliminary Report. That substantial portion of the experimental record which is on videotapes and in informal memoranda is available for inspection at our laboratory. A definitive account of the experiments is not yet available, but will be given in Hepner's and Zellweger's dissertations and in other planned publications. It is clear to us that the two lectures and the lecture preparation represent three very different types of matches between the media on the one hand and the messages and instructional processes on the other. We are beginning to glimpse some fundamental reasons for these differences well enough to guide our planning for further experiments, but we are far from feeling satisfied that we understand what happened, let alone that we know enough to give a recipe for unfailing success in choosing and using media.

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Chapter VI

The preparation for the statistics lectures was an exciting and rewarding process for both participants in spite of their initial confidence in their understanding of a good deal more of statistics than was to be presented to novices in the four lectures. Both became convinced that -- more than anything in their previous experience -- calculating distributions, obtaining and manipulating realistic samples and conducting statistical tests through the computational and graphical display facilities of THE BRAIN raised new questions and helped intuit deep and satisfying answers. Although much time was spent going up blind alleys, gratification far outweighed frustration.

Our attempt in these statistics lectures to make THE BRAIN an animated blackboard used as casually as an ordinary blackboard left us rather puzzled. Perhaps we attempted too much casualness at once: slides prepared on THE BRAIN, demonstration tools such as a wheel-of-fortune marked off with sectors of width proportional to population frequencies, and conventional chalk drawings were also used ad lib (Figure 1); the treatment of statistics attempted in this experiment was deeper, more thorough, and more realistic in intent than in previous years. We have no reason to believe that this intent was fully realized. Certainly, none of the excitement felt during preparation materialized during the lectures. The instructor felt disconnected from the class, which was roused from apathy to a lesser degree than in previous years or in the surrounding conventional lectures.

This experiment did succeed in focusing for us numerous questions of how to package materials and processes, of depth of preparation and degree of informality, of dynamic relationships between the universes of discourse of instructor and students, etc. Detailed analysis of the video tape record of these lecture sessions is enabling us to pose such questions and intuit some of their mutual relationships with what we think will be an unusual degree of specificity and clarity. As one example, we found that certain carefully

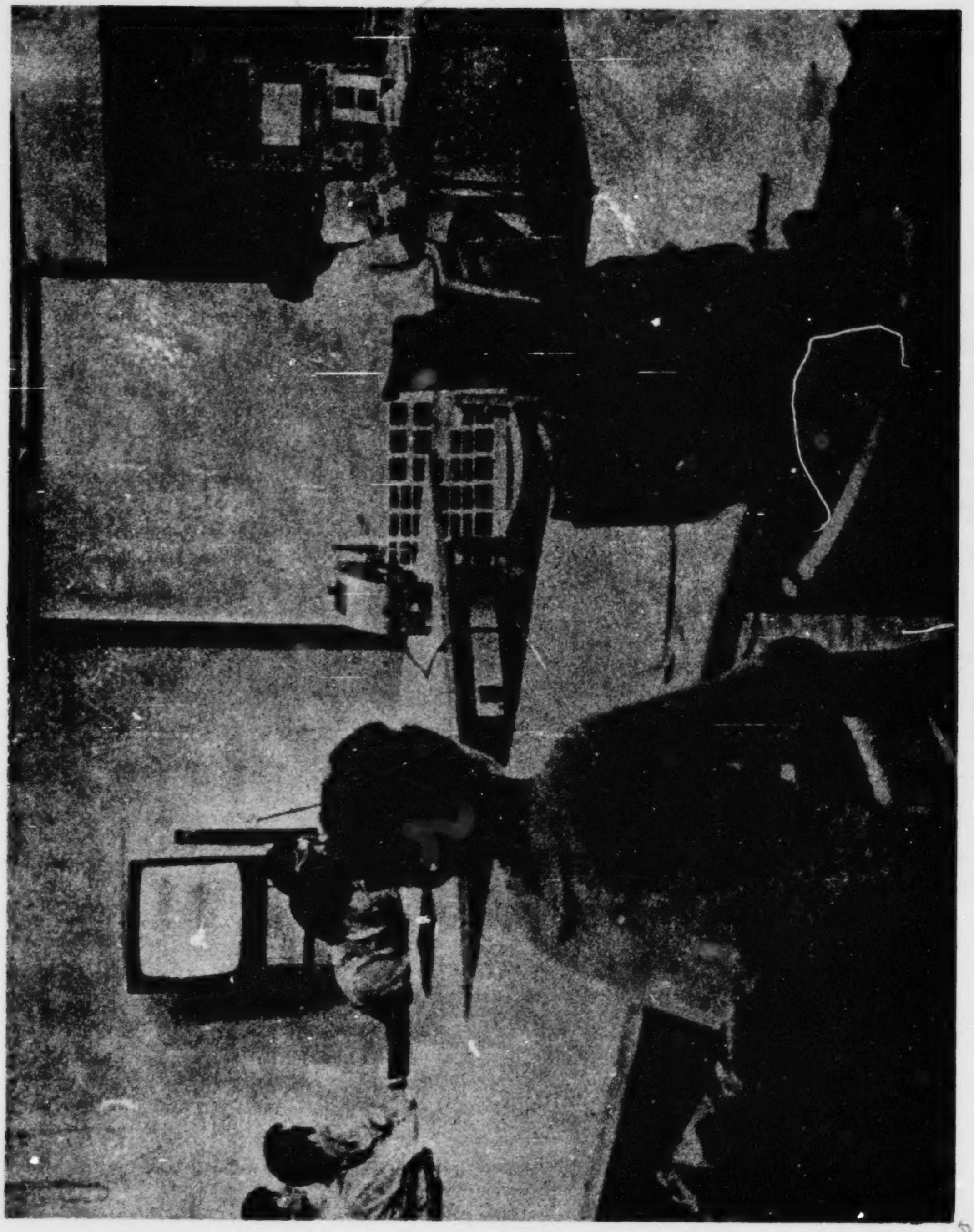

Figure 1. Experimental Set-up: Statistics Lectures.

prepackaged computer or slide demonstrations moved by so quickly that students were unable to grasp a chain of logical development which, by then, seemed self-evident to the instructor. We sense in this problem something more than accident or primitive technique, although both were well in evidence. Although we react quickly to abrupt change in a visual field, we normally watch only slow developments. How much of this is due to intrinsic perceptual limitations and how much to our general lack of formal training in visual perception (other than linear reading) is a question we think will be of fundamental importance. At the same time, the casual step-by-step development of some demonstrations in this experiment required enough excursions into computer methods or statistical manipulations unfamiliar to the students to distract, loose, or bore them in the lecture setting.

[HEPNER 1972 SUGGESTS THAT AN ALTOGETHER DIFFERENT SET OF FACTORS DOMINATES

Simulation is one piece of ground within this bog that is currently thought to be solid. In the biology lecture, the model was exercised by varying parameters in accordance with simple procedures that took the instructor little time to follow in class and, indeed, were simple enough for one student without any previous experience with THE BRAIN to have mastered through personal interaction with the keyboard immediately following the lecture. Thus, in at least one case, this technique created a degree of excitement, a sense of active participation and a conviction of new understanding that matched those of the statistics lecture preparation process with much less cost in time and frustration.

Early utilitarian rewards from the use of THE BRAIN may thus most likely ensue from the preparation of such graphic materials as lantern slides or hard copy, from use in properly constrained simulation contexts, and from service in certain varieties of programmed instruction. Combining a casual

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BY NSF,
HOWEVER, LIMITED USE
IN 1970-71, AND
THROUGH VIDEOTAPE RECC
IN '1971-72 & 72-73
(SEE APPENDIX I-A)

use of THE BRAIN as an animated blackboard, with random access to slides (even with innovations like the slide rack shown in Figure 1) and with excursions to the conventional blackboard is hard work whose eventual payoff remains a matter of conjecture. We think that the ability to modulate one's use of media according to the dictates of substance and process will not be easily attained. It must nonetheless remain one central goal if substance and process are to be the masters of the media and not vice versa. The training of young people capable of molding educational traditions and the development of adaptable educational environments are concomitant necessities.

III. PLANS

A. 1970-71

In keeping with the outlook and objectives summarized in Appendix 1, our efforts will be centered on the presentation to undergraduates of a course "Communication in Societies" (Fall term) and of a seminar "Workshop in Educational Technology" (Spring term). Our tentative description of these two courses, to be offered under Harvard's General Education program, are as follows:

Natural Sciences ~~XYZ~~ 130 - Communication in Societies

Half-course (Fall term) T Th 2-3:30 Professors W. Bossert and A. Oettinger

An exploration of the science and technology of communication among men, animals and machines and of its effects on social organization. Human speech, writing and art and various examples of animal communication will serve to introduce a scientific analysis of the fundamental characteristics of communication systems and of their role in organizing societies. Contemporary problems attendant to the rapid spread of telecommunications and computers will be analyzed to shed light on the interactions between information processing technology and society. The course itself will be an experiment in communication through various new forms of educational technology. Students are expected to contribute to the conduct, the development and the critique of the course through individual or group projects; they will become eligible for participation in the Spring term Workshop in Educational Technology, Nat Sci UVW. Pass fail grading will apply.

Enrollment will be limited to 75 members.

Natural Sciences ~~UVW~~ 131 - Workshop in Educational Technology. Half course (Spring Term). Hours to be arranged. Professors W. Bossert and A. G. Oettinger

Drawing on critical appraisals of the previous semester's experience with Natural Science XYZ staff, processes and materials will be developed for the 1971-72 edition of Natural Science XYZ. Resources permitting, internships for participation in a full-time summer workshop will be made available to qualified students.

Prerequisites: Distinguished performance in Nat. Sci. XYZ. Additional background equivalent to at least one of Nat. Sci. 110, Visual and Environmental Studies 40, or Education P-55 will be helpful.

Enrollment will be limited to 12 members.

This new workshop -- intended for undergraduates and emphasizing the substance of Nat. Sci. XYZ -- would run concurrently with the following graduate seminar, which has emphasized technique since its inception five years ago:

***Applied Mathematics 271. Seminar: Technological Aids to Creative Thought**

Half course (spring term). Hours to be arranged. Professor A. G. OETTINGER.
2230

Selected topics in the history, current state, and future prospects of artifacts for aiding creative thought processes; time-sharing and on-line techniques; applications to education, research and management, includes laboratory work with several local and remote computers, closed circuit television and other devices.

The deliberate interplay of substance and technique in this cluster of courses is evident. The courses are intended also to play another major role, namely to help in training a group of competent and open-minded scholars capable both of developing and criticizing new avenues of education opened by advances in technology. The great mutual benefits derived from the unplanned presence of visitors like Alfred Bork (now at the University of California, Irvine) in the past and Robert Dirkman at present moves us to budget explicitly for one visiting scholar for 1970-71. We think of these combinations of training and collaboration as more productive techniques for the critique and "dissemination" of experimental results (at this stage) than either those caricatures of scientific rigor or those blatantly P.R.-oriented "information-dissemination" programs that tend to be fashionable in educational research.

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In the second half-year period of our exploratory phase under the current grant (January 1, 1970 - June 30, 1970), the principal investigators will concentrate their efforts on detailed planning for these courses. Analysis of the experiments described in the preceding section of this proposal and in our Preliminary Report will also continue, and further influence our planning.

During the summer of 1970, we hope to mount an intensive effort in preparation for the fall course. Our plans for the summer include several precedent-setting steps doubtlessly entailing administrative difficulties as yet unforeseen. We should like to expand our staff during the summer to include people not primarily affiliated with Project TACT. We hope to recruit a group of teaching fellows identified with Harvard's General Education program who will be the teaching assistants during the Fall term of 1970-71, a group of graduate students from the School of Education whose efforts with us in course development and particularly course evaluation would be regarded as credit work toward their degrees in the School of Education, and also a group of people identified with the visual and theatrical arts but willing to bend their talents to our didactic enterprise. Although the director of the General Education program,

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Edward Wilcox, and the Dean of the Graduate School of Education, Theodore Sizer, have both shown strong and friendly interest in these possibilities, detailed negotiations remain ahead of us. We also intend to explore possible participation by graduate students in psychology and social relations concerned with cognitive processes but it now seems most likely to us that fruitful cooperation of this kind is more likely to be achievable in 1971-72, once concrete problems have been isolated for their consideration.

EFFECT ACHIEVED WITH OTHER PERSONNEL

The seminar room used in the Fall term 1969 experiments and illustrated in Figure 1 is incapable of holding the number of students planned for Nat. Sci. XYZ. While agreeably adaptable to the needs of the experiments described in Section II, this conventional room also required an amount of repetitive set-up time that would be prohibitive for the larger scale effort. Coupled with [illegible] aim of attracting a significant number of non-science students to our [illegible], of exploring the possibilities and limitations of variety of technological devices, and of avoiding -- insofar as possible -- a premature investment in hardware, these considerations led to the selection of a lecture room in Harvard Hall as the site of our course in 1970-71.

Harvard Hall is one of the oldest structures in the Harvard Yard and one that students identify with Fine Arts or History rather than with Engineering or Biology. Its lecture room, shown in Figure 2, has recently been refitted with the aid of a Federal Grant to Harvard under the Higher Education Facilities Act (PL88-204). Figure 2 shows the several front-projection, rear-projection, and video screens available as fixtures in that room. The control panel for all this apparatus is shown in Figure 3. Characteristically, no one besides us has exhibited much interest in exploiting any of the more unconventional features of these rather rigid facilities, for which no operating manual was ever prepared.

APPENDIX XI-F + FALLOUT IN SCIENCE CENTER A/V DESIGN

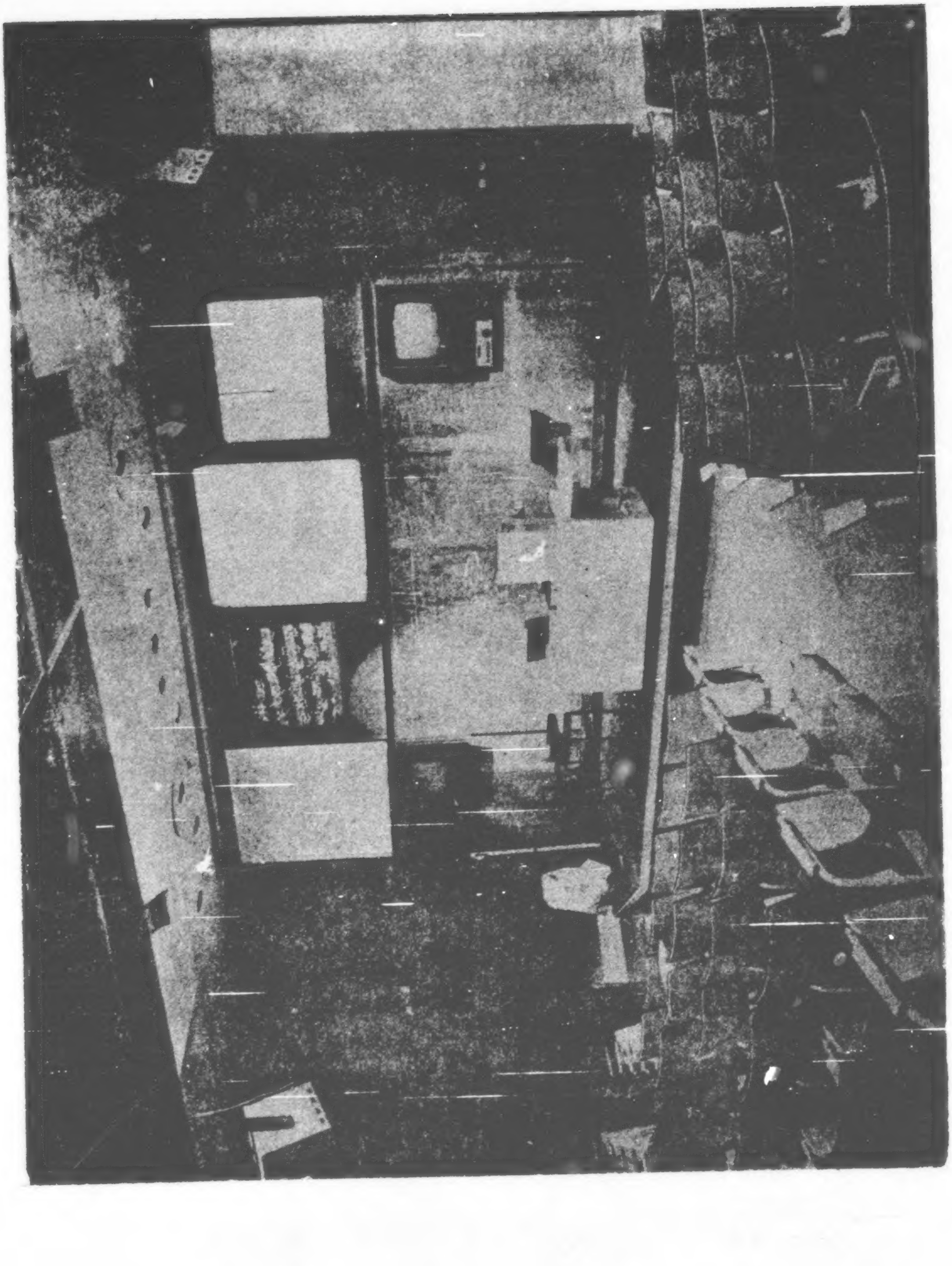
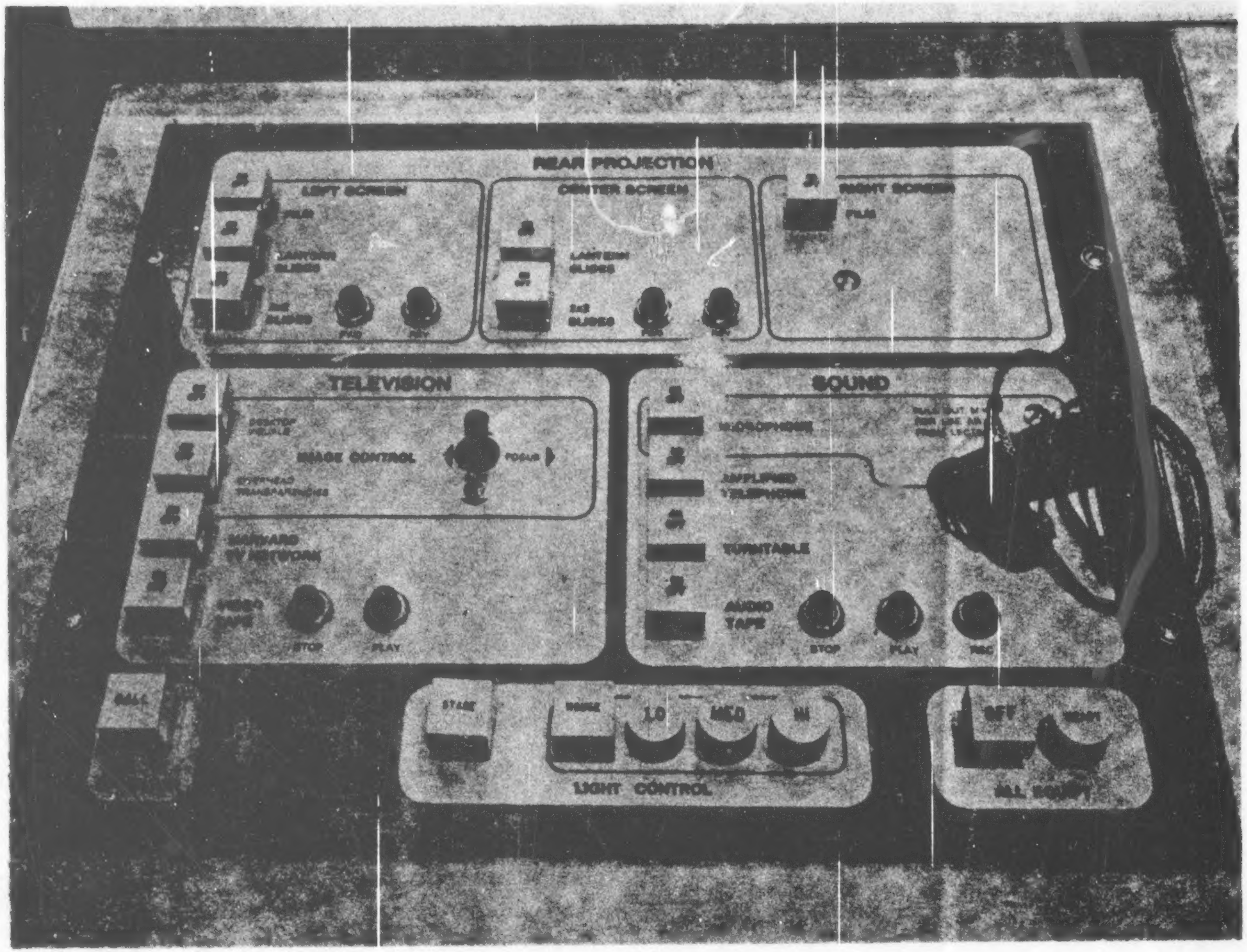


Figure 2. Harvard Hall Lecture Room


REAR PROJECTION
LEFT SCREEN
FILM
LANTERN SLIDES
2x2 SLIDES
FWD
REV
CENTER SCREEN
LANTERN SLIDES
2x2 SLIDES
RIGHT SCREEN
FILM
TELEVISION
IMAGE CONTROL
FOCUS
OVERHEAD TRANSPARENCIES
HARVARD TV NETWORK
VIDEO TAPE
STOP
PLAY
SOUND
MICROPHONE
AMPLIFIED TELEPHONE
TURNTABLE
AUDIO TAPE
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OFF

Figure 3. Control Panel for Harvard Hall A-V Devices.

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Using these facilities as an experimental laboratory will afford us a valuable opportunity to test how far our hypothesis that we are working "in a laboratory situation where political and institutional problems are minimized" will hold. Our plans to secure space in the basement of Harvard Hall for our course development office and studio facilities were pre-empted by prior occupation and remodeling of this basement space by Harvard's Buildings and Grounds Department. We are currently in theoretical possession of a sufficient number square feet in the basement of neighboring Matthews Hall but have found that electrical and communications connections from Matthews Hall to the Harvard Hall lecture room are difficult and expensive to achieve given the current layout and facilities of the Harvard University Broad-Band Information Transfer System. We therefore anticipate an illuminating series of encounters with both the University's Department of Buildings and Grounds and the New England Telephone Company.

APPENDIX I IX)

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In early 1966, the latter succeeded in installing within the premises of the University and at the University's expense a network of coaxial and twisted pair cables, which it managed also to cover within its tariffs (Aopendix II). Given our current understanding of similar practices which telephone companies have followed in other educational institutions, given the importance of questions of control over internal communications channels and of their interfaces and interconnections with the public network, we anticipate that study and precedent-setting in such matters will be a significant component of our activities.

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B. The Longer Term

As our work centered on the cluster of courses described under (A) progresses, we expect it to make its initial mark mainly through migration within Harvard and into other institutions of a growing number of people associated with this work as students, staff, or participants in the associated doctoral and visiting scholar programs. We hope, of course, that conventional and unconventional forms of publication and the distribution of tested materials and processes developed in the course of our work will prove of value elsewhere as early as possible. We think, however, that we can be most effective through an apprenticeship and collaboration system based on the mutual reinforcement of education afforded by the migration of people in and out of our program. Given the great importance we attach to the resolution of institutional problems, we believe that intensive concentration on precedent setting within our own institution and its immediate neighbors will be of LITTLE IF ANY greater value than premature transplantation of partial results.

LIMITED EXCEPT THROUGH STUDENT & ADMINISTRATIVE PROCESSES OF APPENDIX II

SOME PRODUCE (APPEN I A) NOT D (SEE TABU

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We therefore anticipate that our experience in 1970-71 within the setting of Harvard Hall will be transplanted and institutionalized in part in the newly developing setting of the new Harvard Science Center whose site plan and instructional development facilities are illustrated in Figures 4 and 5. As some of our activities shift into this new site, we anticipate increasing collaboration and cross-fertilization with the Harvard Project Physics group under Professor G. Holton with whom we collaborated in the planning of these new facilities.

SIGNIFICANT PROGRESS APP. XI) BUT SINCE BUILDING ONLY BEGINNING TO OPERATE, NO ASSESSMENT OF REAL IMPACT YET AVAILABLE

This new setting will afford us the opportunity to test the viability of the flexibility which we have stressed in our contributions to the planning of the center. For example, we have insisted that little initial effort be made toward the installation of fixed audio-visual facilities anywhere in the Science Center outside the main lecture room areas. We think that

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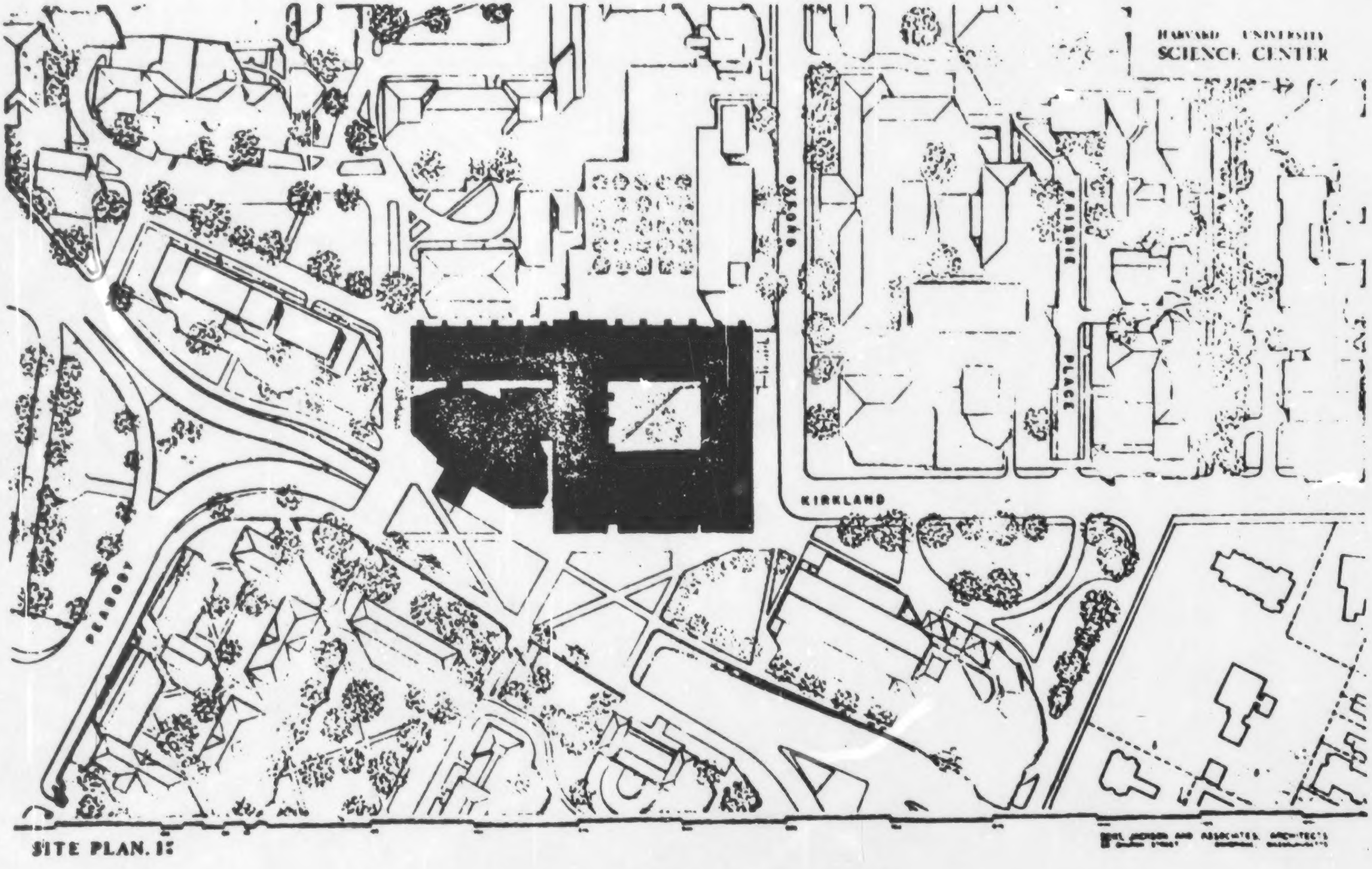
HARVARD UNIVERSITY
SCIENCE CENTER
OXFORD
FRISBIE PLACE
KIRKLAND
PEABODY
SITE PLAN. 1"

Figure 4. Site Plan for Harvard Science Center.

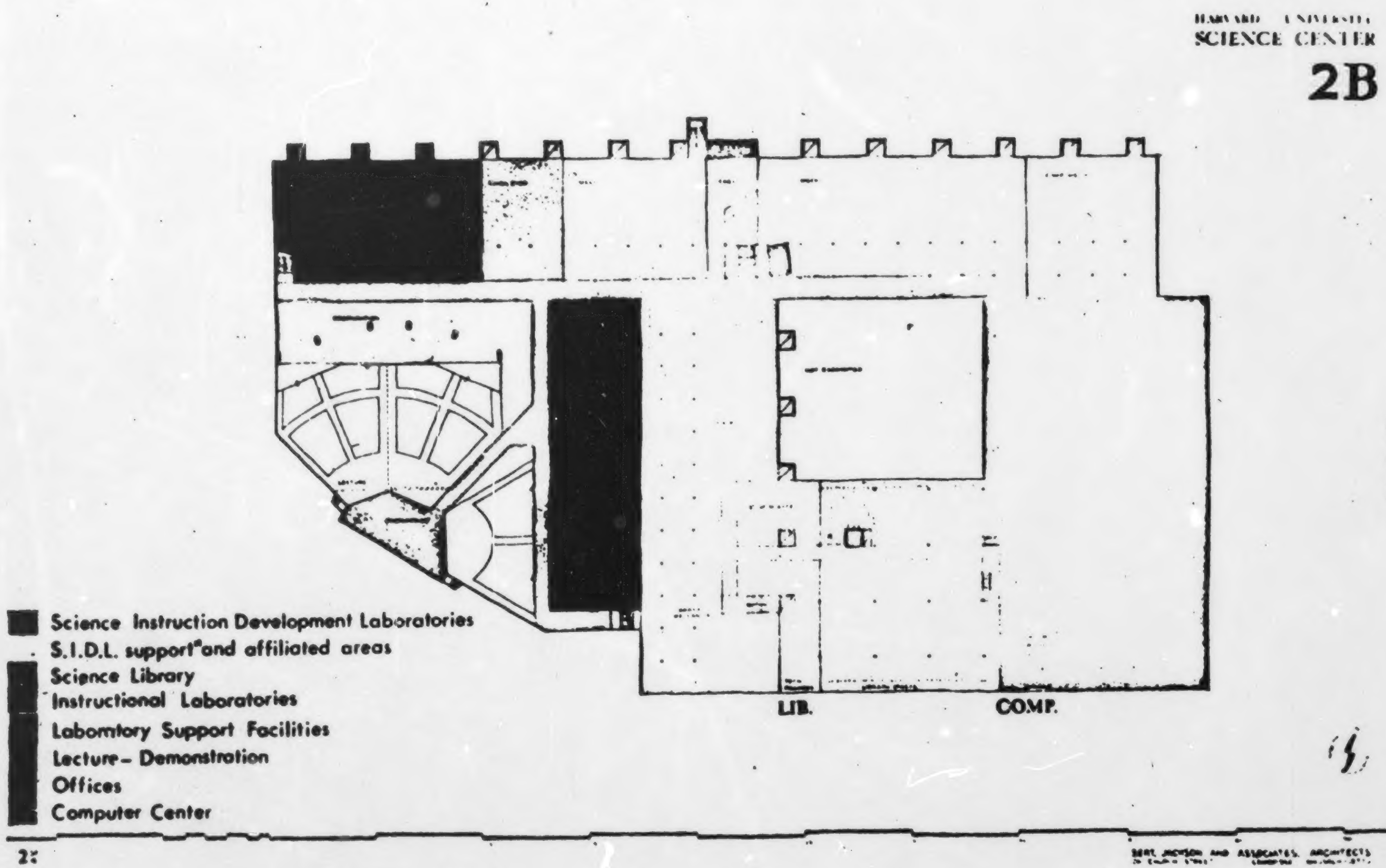
HARVARD UNIVERSITY
SCIENCE CENTER
2B
LIB.
COMP.
Science Instruction Development Laboratories
S.I.D.L. support and affiliated areas
Science Library
Instructional Laboratories
Laboratory Support Facilities
Lecture- Demonstration
Offices
Computer Center
SERT, JACKSON AND ASSOCIATES, ARCHITECTS

Figure 5. Teaching Development, Central Recording, Communications Laboratory, Graphics and Film Processing Space adjacent to main lecture halls in basement of Science Center (Dark Areas).

mobile modular and standardized equipment that can be maintained in the laboratory area and set into classrooms and laboratories as long as required and in working order will prove more effective than fixed equipment. The same concern has driven us to plan for a network of signal communication cables entirely independent of either the electrical power or the standard telephone distribution systems. We have planned for open raceways along the walls of the corridors of each floor; on each floor, these lead to a closet where connections can be made between cables originating or terminating anywhere on the same floor. Each floor closet is adjacent to a vertical shaft for cables running between floors. Through this shaft, all paths ultimately meet in the central recording area planned for the basement. The aim is to afford flexible communications among all floors and, via the central recording and switching area, to and from the Harvard network and the wider world accessible through interfaces to the educational television and the public communication networks. We hope that these provisions for independent and easily accessible distribution channels will permit ready experimentation by the teaching staff, graduate students and others, without the costs, delays, and rigidities inherent in the formal and restricted distribution systems normally associated with power and telephone conduits.

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Preliminary plans for a new building to house the Computer Science teaching and research activities of the Division of Engineering and Applied Physics also call for experimental classroom space combining features commonly associated with classrooms with features commonly associated with audio-visual studios. If realized, these facilities are expected to complement -- at the graduate level and in one specialized professional area -- the facilities afforded at the Science Center for undergraduate instruction in the sciences.

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SOME INTERACTION
WITH MESSRS.
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Active participation by the principal investigators in the planning of facilities of common concern to educational research and educational practice at Harvard and M. I. T. is expected, as these plans bear fruit, to widen the scope of cooperation and of personnel migration still further.

The transplanting of THE BRAIN to McGill University in Montreal expected to take place within the next few months will put us in close touch with still another center of experimentation. If plans for the International Electronic Highway materialize, direct communication links with McGill University and with colleagues at the National Film Board of Canada who, like ourselves, have collaborated in the planning for this link, is expected to add a further dimension to this form of interaction.

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We expect that the embryonic joint efforts with faculty and students from the School of Education and from the Behavioral Sciences anticipated in (A) will mature into programs of research and education whose form cannot at present be clearly discerned. If experience with the diffusion of computer technology within institutions is any guide, it is anticipated that difficult problems of finance and institutionalization will arise as experimental results become fit for routine practice. Traditional funding practices have not been geared to facilitate these difficult transitions. We expect that as occasions draw near, future proposals will include specific recommendations to this effect.

MORE EMPHASIS
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THE STRATEGIC IMPORTANCE OF POLICY ON INFORMATION TECHNOLOGIES THRUST ITSELF UPON US IN COURSE OF [redacted] EXAMINING QUESTIONS DEALT WITH IN OETTINGER/ZAPOL 1972. THIS HAS LED TO CREATION OF A [redacted] RESEARCH EFFORT ON INFORMATION TECHNOLOGIES AND PUBLIC POLICY.

APPENDIX I

Abstract

The Integration of Course Content, Technology, and Institutional Setting

Initial Study Phase

The recent past has seen a great upsurge of interest in educational innovation and particularly in modern technological devices intended to supplement or supplant conventional chalk, blackboards, and books. We believe that, with few exceptions, the net effect has been the introduction into static environments of isolated pieces of expensive equipment that are used little if at all, that are misused more often than used well and that have had only the slightest effect on the quality of our nation's education.

Yet the hope remains that the great potential of modern technology can be realized in order to help solve the major national problem of educating and training a rapidly growing population at all levels from the most elementary through the most advanced to continuing adult education.

We hypothesize that the combination of ill-designed, untried or unreliable technology, of absent or untested content and of ill-trained and unmotivated personnel working in institutional contexts almost ideally adapted to resist change may account for this failure or at least may preclude scientific probing into its causes and an imaginative search for remedies.

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We therefore wish to determine the real potential of an appropriate gamut of educational media in a ~~laboratory~~ REAL OPERATIONAL situation ~~where political and institutional problems are minimized~~ and where the choice of equipment and of the pattern of instruction can be made to flow logically from the intellectual structure of the material to be presented and the capabilities and needs of students.

SEE APPENDICES III - VI

Whether or not this potential can be realized, we wish at least to develop a significant introduction to computer and information science and technology addressed to non-specialists.

AIN THRUST OF REPORT

We therefore expect first to specify the content and then to develop the techniques for teaching an experimental course with the working title "Communication in Men, Animals and Machines."

This proposal is for an initial study phase only, since future requirements cannot yet be foreseen clearly. We have, however, included some guesses as to the future.

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APPENDIX II

A Telco View of an Internal Network

January 25, 1966

HARVARD UNIVERSITY BROAD BAND INFORMATION TRANSFER SYSTEM

The Information Transfer System comprises an origination and a distribution system connecting several locations of the customer. Patching panels, which will control the distribution of the signals, will be furnished by the Telephone Company at two designated locations.

The distribution system will consist of eight (8) standard VHF television channels and two (2) wide-band high resolution 10 MC television channels. The Telephone Company will provide the necessary modulation and line equipment for these channels, and it is not contemplated that there will be any experimentation on this system.

The origination system will ultimately consist of five (5) high resolution television channels between 7 and 110 MC band width. Initially, the Telephone Company will provide the modulation and demodulation equipment for three (3) channels and at a later date furnish the necessary terminal equipment for a fourth channel at appropriate rates and charges. The fifth channel will be used for experimentation in television transmission in the 73 to 83 MC range. The terminal equipment for this experimental channel may be provided by the Telephone Company or by the customer. The type of signals used on this band width (73-83 MC) at any time must be reviewed with Telephone Company Engineers before the customer will in fact attach equipment or impose signals.

The Company does not propose to provide service in the spectrum above 110 MC; however, the customer may use the band width between 200 and 300 MC for data experimentation. The customer will provide the terminal equipment for transmission within this band width and he will consult with Telephone Company Engineers as to the power and characteristics of the signal to be impressed on the line so that an assessment may be made of the potential interfering effects of these experimental signals with those signals in the 7-110 MC range.

The rates and charges for the above mentioned distribution and origination system are a non-recurring charge of $89,000 and a monthly charge of $665.00. In addition, the audio channels furnished other than by means of the coaxial cable and all channels furnished specifically for control purposes will be provided at the filed tariff rates.

The capacity of the facilities in the origination system over and above the television channels as outlined is available for use at no further charge if the customer provides the terminal equipment. However, if additional use of the facilities requires the installation of terminal equipment provided by the Telephone Company, additional charges would apply under existing tariffs or a further extension of the proposed tariff.

This proposed Information Transfer System is subject to the filing of a tariff and approval of same by the Massachusetts Department of Public Utilities before such offering may be put into service.